ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXX. No. 3.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK...........45, 55

Steam Shovels and Steam-Shovel Work (*continued*). 46
World's Columbian Exposition—XVIII, Boilers and Engines.................................... 47
A Vertical Lift Water-Works Intake at Jackson, Miss. (*illustrated*).................................. 49
The Chenab River Bridge and Training Walls; Northwestern Railway, India (*with inset*).......... 49
Excursion Car for World's Columbian Exposition Traffic; Pennsylvania R. R. (*illustrated*)........ 51
Notes from Recent Water-Works Reports............ 52
Tests of Rolled Beams of Bessemer Steel.............. 52
A Steel 150-Ton Pillar Crane........................... 52
Cost of a 1,500-Lb. Pile Driver......................... 52
The Air Brake Exhibits at the World's Columbian Exposition (*illustrated*)........................ 57
A Forthcoming Highway Bridge (*illustrated*)........ 59
Sewage Purification in America; Canton, O.......... 60
The Fire at the World's Columbian Exposition (*illustrated*).. 61
To Draw Red Lines on Blue Prints..................... 62

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS....................................52, 53

EDITORIAL NOTES.................................. 54

Engineering Headquarters at the World's Columbian Exposition—Suspension of Work on the Nicaragua Canal—Report on Tests of Structural Material at the Engineering Congress—The U. S. Forestry Division on Tapped and Untapped Pine Timber—Heads of Engineering Schools—American Armor-Plate Tests—Mr. Waddell's Proposed Compromise System of Live Load for Railway Bridges.

EDITORIAL:

The Congress of Aerial Navigation.................... 55

LETTERS TO THE EDITOR........................... 56

Collecting Samples of Water (*illustrated*)—Concerning Ideal Engineering Education—The Cost of Living in Chicago—Fees of Engineers—Relative Friction of Air and Water—Use of Planimeter in Railway Practice—Pennsylvania Marble—A New Telemeter Target (Correction).

CONSTRUCTION NEWS.............................62, 64

Railways, Street Railways, Elevated and Cable Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Contract Prices, Miscellaneous.

INDUSTRIAL NOTES.................................. 64

An Aerial Navigation Congress is to be held at Chicago this summer, Aug. 1 to 3. The local committee is composed of engineers and university professors who have made an effort to elicit papers and discussions from capable scientific investigators throughout the world. The secretary, Prof. A. F. Zahm, of Notre Dame, Ind., has received valuable papers describing the recent experiments of inventors in this and the European countries, England, Algeria and Australia. Among the contributions are photographs and descriptions of several successful steam flying machines and of the great military balloons of twelve different nations.

The membership of the Institution of Civil Engineers now stands as follows in a new list of members just issued, to which we add the corresponding figures for August, 1889:

	June 3, 1893.	Aug. 1, 1889.	Incr.
Members	1,821	1,667	154
Associate Members	3,424	2,650	774
Associates	373	448	–75
Students	811	989	–178
Total	6,429	5,754	675

The grades of Associate and Student have both declined somewhat, but there has been a large increase in the two grades of corporate membership, especially the junior grade.

The signal system being installed on the Broadway cable railway in New York City to enable rapid and convenient communication between any part of the line and the power stations in case of accident is unusually complete. In consists, briefly, of signal boxes placed in the street just outside of the tracks, at intervals of from 500 to 700 ft.; somewhat closer in the lower part of the city than the upper, and placed as convenient as may be, to points where difficulty and obstructions are specially to be apprehended. In case of trouble, the gripman or conductor lifts off a small cast iron cover, which is not locked, and then, lifting another waterproof cover below that discloses a pull by which such signals as "stop," "start," "fire," "blockade," etc., may be sent to the power-stations. As soon as the "pull" is released, a hand on a large dial in the engine room of the station points to a corresponding signal which is also struck on a large gong. Immediately the number of the box from which the signal is sent is struck on a smaller gong of different tone, informing the engineer as to where the trouble has occurred, while at the same time the signal number and box number are automatically printed on an endless tape, much after the fashion of an ordinary stock ticker. Should the engineer forget the signal sent, he has a permanent record of it, together with the time at which it was received. Provision is also made in each signal box for the temporary attachment of portable telephones, to be carried by certain officials. It will be thus possible to talk from any box to the power station—this is in addition to the ordinary telephone instruments with which all the stations are supplied.

Work on the Pacific Short Line bridge across the Missouri River at Sioux City, Ia., which was discontinued May 1, has not yet been resumed. The present status of the work is as follows: Beginning at the Iowa shore pier 2, one of the draw rest piers is completed except the coping; pier 3, the pivot pier for the Iowa swing span, is also completed except the coping; pier 4 is sunk to a depth of about 45 ft. below low water; and pier 5 is down about 20 ft. deeper. The steel caisson for pier 7, the Nebraska pivot pier, has been delivered, and riveted up on shore, while the steel for pier 6 has been delivered, but not riveted up. Nearly one-half of the steel for the superstructure has been rolled, and a small portion of it manufactured. The Phoenix Bridge Co., of Phoenixville, Pa., is the contractor for the superstructure, and Sooysmith & Co., of New York, N. Y., are the contractors for the substructure. Mr. J. A. L. Waddell, M. Am. Soc. C. E., of Kansas City, Mo., is Chief Engineer, and Mr. Lee Treadwell, Jun. M. Am. Soc. C. E., is Principal Assistant Engineer in charge of the work.

The most serious railway accident of the week was a derailment July 13 on the New York, West Shore & Buffalo R. R., near Newburg, N. Y. A northbound express train due at Newburg at 12:04 p. m. left the track at a switch and ran into a freight train standing on the side track. Seven persons were killed and 22 injured. The switch and signal were interlocked, but a new switch had been put in on the morning of the accident, and the bolts of the interlocking rods were therefore removed, and had not been replaced when the express was due. The switchman claimed that he had pulled both levers (one for switch and one for signal) and that the switch was set right for the main track. The coroner's jury decided, however, that the switch had not been properly set.

A serious grade crossing collison occurred at Chicago, July 17, at the 49th St. crossing of the Chicago & Grand Trunk Ry. As a crowded southbound Halsted St. horse car reached the crossing, a long freight train going west had just passed, and the tower man had raised the gates. This was taken as a signal that the way was clear, and the driver whipped up his horses as he started to drive across the tracks. Previously, however, the conductor had gone ahead, and not seeing the approaching passenger train, because of the freight, he motioned his driver to go ahead. The watchman in the tower saw the passenger train and lowered the gates, but was too late, for the street car was already on the tracks. The car was thrown from the track and smashed. Three persons were killed and about ten injured, some seriously.

The South Water St. bridge, at Cleveland, O., which crosses the old Ohio canal bed now occupied by the Ohio Valley R. R. tracks, gave way July 12 under three heavily loaded garbage wagons. The bridge was about 50 ft. long and 25 ft. above the tracks. It was an iron structure about 40 years old, whose weakness was known, but it is said the drivers of the wagons were racing to the dumping grounds. Two men were injured. The city will erect a new bridge very soon.

A New York highway manual has been issued, as provided by act of legislature of last winter, and in accordance with the general demand for better roads. This manual contains the general laws relating to the powers and duties of highway officers and resident taxpayers. It also gives some practical suggestions and directions for the proper construction and maintenance of highways. It was prepared by Mr. N. H. Spalding and the Commissioners of Statutory Revision.

Railway management in Australia has always been notable for somewhat peculiar methods and for sharp prejudices, and now the Railway Commissioners of Victoria have discharged their Locomotive Superintendent, Mr. Allison Smith, in great haste, mainly, it seems, because he was too progressive. The Melbourne "Argus" states that the alleged reason was the abolition of the office as a means of retrenchment, but as another engineer was appointed Chief Mechanical Engineer, the office is retained under a new name. According to the paper the real reason is that Mr. Smith was personally disliked by one of the commissioners, who succeeded in getting him discharged, with three months' salary in place of notice. Mr. Smith had introduced improved first-class passenger cars and improved cattle cars, the latter of which were specially commended by the trade, as the animals were carried more comfortably and with less injury than in the old style of cars. The new cars carry 10 cattle or 100 sheep comfortably, while 9 cattle or 80 to 90 sheep were packed into the older cars.

The improvement of the navigation of the River Rhine is to be undertaken by the German and Swiss governments. The improvement will embrace the Upper Rhine, commencing at Lake Constance, and as planned will cost about $3,312,000 and take 14 years to complete.

Torpedo nets for cruisers seem to be lightly regarded just now by French naval authorities, and they have decided to do away with them at the bow and stern and may abandon them altogether. They say that the loss of speed resulting from the use of nets increases the chances of being hit in a degree out of proportion to the protection afforded.

River improvement on the lower Weser River, in Germany, is to be carried out on a rather novel plan. The commission for the regulation of the river is advertising for bids for the supply and delivery of machines which, being attached by tackle to the stern of a steam tug, will tear up the bottom of the river so that the suspended material (fine sand, mixed with mica, clay and shells) may be carried away by the current. The conditions may be obtained from the Central Buereau der Unterweserkorrektion, Werderstrasse 22, Bremen. Bids, with drawings, descriptions in German, English or French, and models of the proposed apparatus, must be delivered at the bureau by Aug. 15.

A plan for providing a supply of pure water for Chicago has been promulgated by Mayor Harrison. He proposes to grant a syndicate the right to construct a pleasure island in Lake Michigan, six or seven miles from the shore, in consideration of which right it is to extend the present 2½-mile tunnel three or four miles farther into the lake, to connect with a crib, to be built in the center of the island. Gen. Fitz Simons, a civil engineer, of Chicago, is reported to have stated that he would form a syndicate if granted such a privilege. Investigations are to be made, and a memorial sent to Congress requesting the right to prosecute the work. Mr. Harrison's plans include utilizing material now in use at the World's Columbian Exposition. He also proposes extending the other tunnel farther into the lake next year, and states that the 2½-mile tunnel will be extended whether the syndicate scheme is carried out or not.

The ironwork for the bridge across the Missouri River at Leavenworth, Kan., is being shipped from the shops of the Union Bridge Co. The bridge will consist of two 330-ft. fixed spans and a 440-ft. swing span with solid earth approaches. It is being built by the Leavenworth Terminal Ry. & Bridge Co., and will carry a single railway track and a roadway; the railway track being simply planked over to form the roadway. The two abutments will be of masonry on pile or concrete foundations, and the three river piers will be of masonry on pneumatic caissons. Work was begun on the substructure about June 1. The contractor for the entire work is the Union Bridge Co., of New York, N. Y., who sublet the contract for the substructure to A. J. Tullock, of Leavenwoth, Kan. George S. Morison, M. Am. Soc. C. E., of Chicago, is chief engineer.

Professor Nansen, who set out from Christiana about two weeks ago on his proposed drift to and across the North Pole, has taken precautions for a possible return. His vessel, the "Fram," is provisioned for five years, and, not wishing to dispose of any of the stores on board, he has sent a special party to leave stores at two points on the island of Kotelnoi, the largest of the New Siberian Islands, say press dispatches. These depots are to be inspected in 1894 and 1895 to see that they are serviceable. If he should lose his ship before reaching the North Pole Professor Nansen intends then to retreat south over the ice, either back to these islands or to the open waters of the East Greenland Sea. These New Siberian Islands form the group upon one of which the "Jeannette" was wrecked in 1881; they lie in about 76° north latitude and 140° east longitude from Washington, northeast of the mouth of the Lena River, in Siberia.

The promoters of the Topeka, Kan., dam are again making vigorous efforts to push that enterprise. The city of Topeka has, through its city councils, subscribed for 600 HP. at $40 per year each, or $24,000. Part of this would be utilized in producing electric light, and the Chicago-Topeka Light, Heat & Power Co. hope that this contract will induce citizens to subscribe more freely.

STEAM SHOVELS AND STEAM SHOVEL WORK.*

By E. A. Hermann, M. Am. Soc. C. E.

Part II.—Steam Shovel Work.

(Continued from page 603.)

On all but very small pieces of work the cars should be provided with hinged drop sideboards, Fig. 79, using either of the arrangements shown in Figs. 80 and 81, which will enable them to carry 12 to 14 cu. yds. instead of 6 or 7. The side boards are made in two pieces on each side of the car, Fig. 79. Those shown in Fig. 80 are used for both center and side plows; they can be quickly dropped by a man walking along the train, after arriving at the unloading place and striking the hook A an upward blow with a light hammer. The boards are hooked up again after the cars have been returned to the steam shovel pit. The side boards shown in Fig. 81 are used where the side plow only is used. Here the board on one side only (the unloading side) is hinged (or chained), and dropped by pulling out the pin B, thus leaving that side of the car entirely unobstructed for unloading the material; the board on the other side of the car is bolted to the stake in the stake pocket and is not moved.

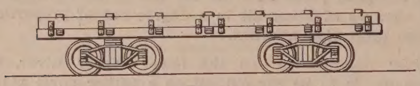


Fig. 79.

The cars should also be provided with sheet iron aprons, Figs. 82 and 83, extending from the end of one car onto the floor of the next, to prevent the material from falling on the track between the cars as the plow is drawn over them, and delaying the departure of the train until it can be shoveled out. These aprons are made either in two pieces, Fig. 82, or in one piece only, Fig. 83. The former are more easily handled, and permit access to the coupling of the cars without lifting the apron. Very little material drops on the track when the aprons and the center plow are used. The single apron is used mostly in connection with the side plow.

The number of cars and engines required for each steam shovel to keep it in nearly constant operation depends upon the nature of the material excavated, the length of haul, and the density of other traffic upon the main line. This number must be determined by accompanying circumstances in each case; ordinarily, however, it averages about as given in Table III.:

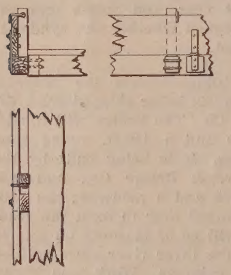


Fig. 80.

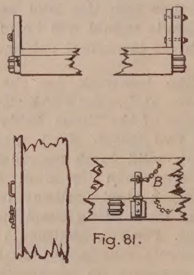


Fig. 81.

Table III.

	In the steam shovel pit.		On the road up to— 10 mls.		25 mls.		50 mls		75 mls.	
	Loco.	Cars.	Loco.	Cars.	Loco.	Cars.	Loco.	Cars.	Loco.	Cars.
Loose gravel	1	30	1	30	2	60	3	90	4	12
Dry clay	1	22	1	22	2	40	..	..	..	..
Damp stiff clay	1	18	1	18	2	36	..	..	..	..
Hardpan, cemented gravel, etc., loosened by explosives	1	16	1	16	2	32	..	..	..	..

The length of haul usually ranges from 2 to 15 miles; it seldom exceeds 25 miles for any material except gravel ballast, where hauls of 75 miles are frequent, and sometimes reach 200 miles.

On hauls exceeding 25 miles the full number of cars and engines required can seldom be obtained, and the output of the steam shovel is correspondingly decreased. The delay in returning empty cars due to detentions from other trains is the great trouble most keenly felt in steam shovel work on railways in operation. The so-called "mud train" is generally considered an outcast, and is usually the last train to receive the dispatcher's attention for an order to the road. These delays are daily occurrences, and it is quite an exceptional case when the machine is amply supplied with empty cars. The record of most steam shovels on such work is therefore a rather poor one, when the machine really made a good showing for the crippled condition of its car service. Some of these delays can be avoided or shortened by stationing a telegraph operator at the outgoing end of the pit, and on all but very small pieces of work his wages will be many times balanced by the time gained in keeping the whole plant moving, by obtaining train orders quicker, and remaining constantly informed of the whereabouts of the construction and other trains, and regulating the work in the pit accordingly.

For general construction work where the excavated material is not loaded on standard gage railway cars, small dump cars, Figs. 84 and 85, are generally used. They are more economical than wagons or carts, which are employed only in special cases, mostly in cities, where the material must be hauled some distance over several intersecting streets, and where a track will not be allowed; or for very small jobs with a long haul which would not justify building a track.

The gage of these tracks is usually 2½ or 3 ft., sometimes 2 ft. or even 1½ ft. only; the latter gages are not often used, and the 3-ft. gage is usually preferred.

The rails most generally used weigh 20 lbs. per yd. Although these tracks are only temporary their construction should be fairly substantial; but they are often built in an exceedingly careless and insecure manner, causing a great waste of power in pulling the cars over them, and resulting in frequent delays, due to derailments. The grade is usually arranged so that the loaded cars will run downhill by gravity, and only the empty cars need be drawn back to the pit. On small work, horses or mules are used to pull the cars, but on large jobs small locomotives are employed. Small dump cars vary in capacity from 1 to 3 cu. yds., the latter size being most generally used. The side dump car, Fig. 84, dumps on either side. The rotary dump car, Fig. 85, unloads on either side or end; the box can be turned around horizontally, revolving about a vertical pin in a turntable on the frame; they are used mostly in dumping off the end of a fill.

In making fills it is nearly always the best plan to build a temporary trestle of round pieces of beech, cottonwood or other cheap trees, old bridge or building timber, or other second-class lumber, and then filling in with the side dump cars. By adopting this plan the unloading will progress much more rapidly than by dumping from the end of a fill, where only one car at a time can be unloaded. These trestles are inexpensive, and the saving in labor and time in making the fill will amply repay their cost.

Unloading the Material.—On railways the unloading is seldom done by slow and expensive hand labor with the shovel; sometimes dump cars are employed, but in most cases flat cars and the plow are used. The trains consist of 10 to 30 cars. The car carrying the plow is attached to the rear of the train at the nearest side track to the unloading place, if it is not over 10 miles from the steam shovel pit this car is generally carried back and forth to avoid an extra stop to couple it on the train at the sidetrack. One end of a steel wire cable is then hooked to the plow and the other end (which is attached to an ordinary car coupling link) coupled to a car or the engine. Usually this cable is about 400 ft. long and extends over 12 cars. The brakes on these cars are then set up tight and the engine started with the forward cars, Fig. 86. In very tenacious or partially frozen material the rear cars are sometimes pulled along by the plow; the wheels are then blocked with pieces of wood or with stones; sometimes it is even necessary to chain a few of these cars to the track to prevent the rear lot of cars from moving. After the plow has been started, it is drawn along slowly until it arrives on the last car, Fig. 87. The engine is then stopped and backed up a few feet to permit the cable to be thrown on one side of the track, Fig. 88. The train is then backed up again and coupled to the unloaded cars, when four to six men throw the cable on the next loaded cars, Fig. 89, coupling its forward end to a car or to the engine if the cable is long enough. The operation is then repeated until all but the car next to the engine is unloaded; this car carries the plow and is the first car to be unloaded by the next train. The ends of the cable are then detached from engine and plow, thrown to one side of the track, and left there for the next train to pick up and use in the same manner.

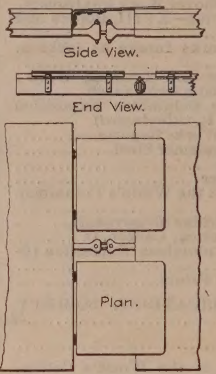


Fig. 82.

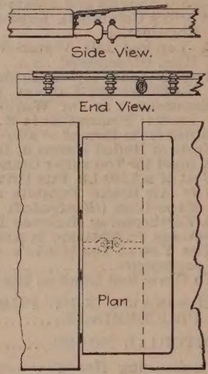


Fig. 83.

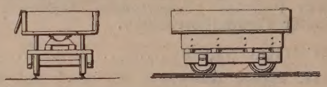


Fig. 84

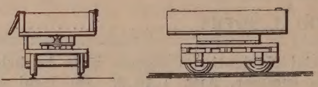


Fig. 85.

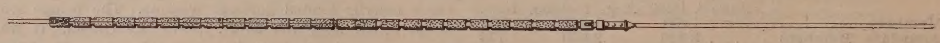


Fig. 86.

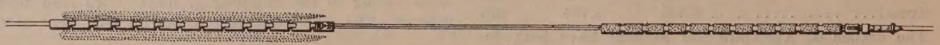


Fig. 87.

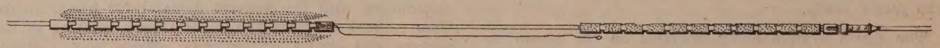


Fig. 88.

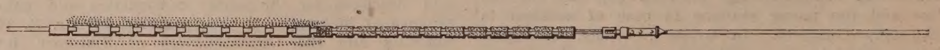


Fig. 89.

When filling a trestle the cable cannot be thrown on one side, as described, but must be unhooked from the plow (the rear lot of cars being left standing on the trestle), dragged across the trestle, and there thrown to one side. The forward lot of cars is then backed up until its rear car is opposite the rear end of the cable, when it is loaded, the train backed up, coupled and unloaded, as before described. After unloading the train the cable must again be dragged beyond the trestle, and there thrown to one side of the track and left for the next train. The time required for unloading varies from 10 to 30 minutes, depending upon the nature of the material and the number of cars, and averages about 20 minutes, doing as much work in that time as 20 men can do in a day.

---

*Copyright, 1893.

When unloading on curves the operations are delayed by the necessity of using snatch blocks on the cars to insure a nearly tangential pull of the cable and avoid pulling the plow off the car. These blocks are applied as shown in Fig. 90, and at A, Fig. 91. They are hooked to long chains extending over the car and fastened to the bolster or arch bar of the truck. The number of snatch blocks required depends upon the degree of the curve and the length of the cable; generally four to six blocks, one to every third car, are enough. As the plow approaches one of these blocks it must be stopped, block and chain removed and transferred forward for use at that end of the train. The other operations of unloading are the same as when on straight track. The time required in unloading on curves varies from 20 minutes to an hour, and averages about 40 minutes, doing as much work in that time as 20 men can do in a day.

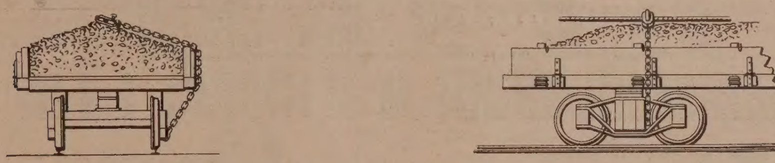


Fig. 90.

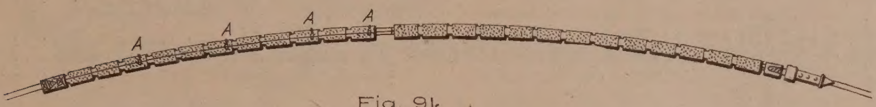


Fig. 91.

The steel wire cables used vary from 1 in. to 1½ ins. diameter. The former are used for unloading loose gravel and sandy material; they are light and easily handled, but cannot bear much jerking. The most usual size is 1¼ ins. diameter. Heavier cables require too many men (six to eight) to load them on the car preparatory to starting the plow.

One of the heaviest locomotives on the road (preferably one of the consolidation type) should be used for drawing the plow over the cars. These engines are generally able to keep the plow moving with a strong steady pull, avoiding the necessity of taking a run to start the plow, and all injurious jerking of the cable, which frequently breaks it. For tenacious materials and where the haul is not more than 25 miles, it is often good policy to keep one heavy engine at this work, the other engines merely hauling the trains; this can generally be arranged so that no more engines are used than if each engine were to unload its own train. Sometimes two light engines are used for this purpose, but they can seldom move in perfect unison and more or less jerking is the result. Unfortunately the engines for the "mud trains" are not always in the best working order; they are mostly those which are about to go into the shops for turning down the tires or for general repairs, and are not in fit condition for general traffic, but still considered good enough for this service. Expensive delays due to badly working engines are frequently the result.

The locomotive in the steam shovel pit should always be equipped with a steam or air driver brake to assist in quickly stopping the cars at exactly the right place when setting them for loading by the steam shovel. For the same reason the brakemen should be allowed to use short sticks in the brakewheels to obtain a greater leverage in turning them.

Both engine and train crews should be changed as little as possible and they should retain their respective trains in the pit on the road or at the dump. Most of the men dislike the "mud train" service, but some (especially the older ones) are glad to get a steady job with a full night's rest, and these are the men to be chosen. They take an interest in the success of the work, and soon acquire an expertness in handling cars, plows, etc., that makes them worth twice as much as the inexperienced or unwilling ones. The wages of these men should be equalized to average the same as the men on the road in other service, otherwise dissatisfaction and indifference are sure to result.

(To be continued.)

WORLD'S COLUMBIAN EXPOSITION.—XVIII.

Boiler Plant.

The main power plant and the oil fuel supply have already been described in our columns, and we now give some further details of the plant, for the revision and correction of which we are indebted to Mr. Charles F. Foster, Mechanical Engineer of the Exposition. In the main power plant 52 boilers, all of the water tube type, generate steam to drive 86 engines and compressors. These boilers have a rated power of 20,575 HP.; but are capable of developing a power greatly in excess of the rating within the limits of economy. They evaporate about 750,000 lbs. of water per hour and burn about 50,000 lbs. of oil in the same length of time. One pound of oil will evaporate about 15 lbs. of water. Assuming the evaporation to be 750,000 lbs. of water an hour, the power generated would be 25,000 HP.

The boilers in the power-house are furnished by eight exhibitors, as described in our issue of April 13. The number of boilers and rated horse power are as follows: four Abendroth & Root boilers, 1,500 HP.; four Gill boilers, 1,500 HP.; eight Heine boilers, 3,750 HP.; four National boilers, 1,500 HP.; nine Campbell & Zell boilers, 3,750 HP.; ten Babcock & Wilcox boilers, 3,000 HP.; four Stirling boilers, 1,800 HP. In the annex are four Heine boilers, 1,875 HP.; three Climax boilers, 2,000 HP.; and two Stirling boilers, 900 HP. These boilers, while separated from the main boiler-room by the south entrance to Machinery Hall, are connected with the main system the same as the other batteries. All the boilers are of much the same type, except the Climax, which is vertical, with U-shaped tubes opening into the central drum. The largest boiler is a Climax of 1,000 HP.

The Abendroth & Root boilers have 126 tubes 4 ins. diameter by 18 ft. long, arranged in courses 14 wide by 9 high. They have 7 drums 14 ins. diameter by 20 ft. long, and one header 30 ins. diameter by 12 ft. long. The Gill boilers have 360 tubes 4 ins. diameter by 18 ft. long, three steam drums 42 ins. diameter by 21 ft. 3 ins. long. The Heine boilers have each two drums 36 ins. diameter and 19 ft. 6 ins. long, 171 tubes 3½ ins. diameter and 16 ft. long, and a steam drum 2 ft. 6 ins. diameter and 7 ft. 6 ins. long. The National boilers have 180 4-in. tubes 18 ft. long and three steam drums 36 ins. by 20 ft. The Campbell & Zell boilers have 236 4-in. tubes 18 ft. long, three 30-in. water drums 19 ft. long, and one steam drum 52 ins. diameter by 12 ft. long. The Babcock & Wilcox boilers have 126 4-in. tubes 18 ft. long, arranged in courses 14 wide and 9 high, a mud drum 12 ins. diameter and 8 ft. 6 ins. long, and two steam drums 36 ins. by 18 ft. The Climax 500-HP. boilers have a main shell 42 ins. diameter by 29 ft. high. The main shell is ¾ in. thick, with vertical seams welded. Each has 475 tubes 3 ins. diameter and 11 ft. 6 ins. long before bending. The 1,000-HP. boiler has a main shell ⅞ in. thick. It is 54 ins. diameter and 35 ft. 3 ins. high. It has 864 3-in. tubes which were 12 ft. 6 ins. long before bending. It is capable, it is said, of developing 1,800 HP. The Stirling boilers have 335 tubes 3¼ ins. diameter, three drums 3 ft. diameter and 14 ft. 6 ins. long, and one drum 3 ft. 6 ins. diameter and 14 ft. 6 ins. long.

These boilers, with the exception of one Campbell & Zell and the three Climax, are arranged in batteries of two. Each pair of boilers feeds steam into one common pipe which delivers into the 36-in. steam headers under the gallery floor. Of these headers there are seven; five in the main boiler plant and two in the annex, the longest being 158 ft. in length. The headers are connected by pipes 10 ins. diameter, except that between the main boiler plant and the annex, which is 12 ins. diameter. These connecting pipes are arranged with elbows and nipples to allow for expansion. The main headers are securely fastened in the center to large masonry foundations. They are further supported every few feet by rollers placed on foundations of masonry. These rollers permit the headers to expand freely in each direction.

A 4-in. drain pipe runs the whole length of the boiler plant and discharges into a large tank outside. The headers are connected with three 2-in. drain pipes, so that in case of emergency, if a battery of boilers should get to foaming, for instance, they can be quickly emptied. The water of condensation is carried back into the boilers by the Westinghouse steam loop.

The boilers are fed by pumps and injectors of various makes, all being listed as exhibits. The Abendroth & Root boilers are fed by means of six Watson injectors and two Deane pumps 7½ × 4½ × 10 ins. The Gill boilers are fed by two Korting injectors and two Barr pumps, one 10 × 6 × 12 ins., the other 10 × 6 × 10. The pumps supplying these boilers are regulated by a Thomas automatic feed water regulator which keeps the water at a constant level without the intervention of an attendant. The Heine boilers are supplied by eight Pemberthy injectors, two Knowles pumps, 10 × 5 × 12, and two Blake pumps, 8 × 5 × 12. Four Hayden & Derby injectors and two Davidson compound pumps 12 and 20 × 10½ × 20 are required to supply the National boilers. The Zell boilers are supplied by six Nathan injectors, one Cameron pump 8 × 4 × 12 ins., one Laidlaw & Dunn 7½ × 4½ × 10, one Wilson-Snyder 14 × 8 × 18, one Canton 8 × 5 × 8 ins., one Worthington 6 × 4 × 6, and one Boyts-Porter pump 16 × 8 × 18 ins. The Babcock & Wilcox boilers are supplied by five Hancock inspirators and three Snow pumps; one is compound 8 and 12 × 7 × 12, the others are 10 × 6 × 10 and 8 × 5 × 10, respectively. Two Buffalo pumps 10 × 6 × 10 and 7½ × 5 × 8 and one Gould pump run by an Ideal engine, and six Schaefer & Budenberg injectors are used to feed the Stirling exhibit. In the annex two Marsh pumps 10 × 6 × 12 ins. and three Sellers injectors supply the Heine boilers; the Climax boilers are fed by one Blakeslee 10 × 6 × 14, and one 12 × 7 × 12 Smedley, and the Stirling boilers are supplied by one Hall 8 × 5 × 10, and one McGowan pump 8 × 5½ × 10, and four Hancock inspirators. On every make of boilers is a feed header, into which the pumps of those boilers deliver. From this header separate pipes are run into each boiler.

Oil is the fuel used. The oil is atomized by a steam jet as it is discharged from the burner into the furnace. The various makes of oil burners are shown in operation. There are 12 Reid burners under the Abendroth & Root boilers, 16 under the National, and 16 under the Campbell & Zell; 30 Larkin burners under the Babcock & Wilcox and 28 under the Climax; 16 Armstrong burners under the Gill boilers. The Heine boilers use 16 Graves, 16 Burton, 8 International, and 12 Reid burners; the Stirlings use 8 Burton and 8 locomotive burners. A 5-in. oil pipe runs the entire length of the boiler-house. This header is tapped frequently and every battery of two boilers is supplied through a separate pipe. The pressure, as allowed by the underwriters, is 6 lbs. per sq. in. Running along the tops of the boilers from one end of the boiler-hose to the other is a 2½-in. steam pipe with valves between each make of boilers. A 2-in. steam pipe feeds into this from each boiler. From this 2½-in. pipe steam is carried into the oil burners for atomizing the oil. As steam is necessary to burn the oil, this pipe obviates the necessity of using wood to start up any battery of boilers after it has been allowed to cool down so long as any other battery has steam up. The Gill and the Campbell & Zell boilers have independent steam connections with the burners in addition. The safety valves are of the ordinary pop pattern, set at 125 lbs.

The boiler-house is in charge of a superintendent, whose rank is that of second assistant engineer. Each exhibitor furnishes firemen and water tenders to care for his boilers. They work in watches of eight hours each, one or two men being required, according to the number of boilers in the exhibit. In addition the Exposition furnishes a gang of 24 men under three foremen, who look after cleaning, oil and oiling, repairs, alterations and so on. One man's duties consist in watching for smoke and promptly reporting any offense in this particular. He sits in a little house back of the boiler-room, where he has a clear view of all the chimneys. Electric communication with every furnace is provided, so that as soon as a chimney begins to smoke the fireman is warned by a bell to look after the matter. Another man looks after the valves, of which there are 108 on the headers alone, and a grand total of 1,200 in round numbers in the boiler-house.

Mr. Geo. Ross Green, the Superintendent, has devised a scheme for keeping a record of the condition of the boilers and engine. On the north wall of the boiler-house, near the center of the gallery, hang two large blueprints. On one is a diagram of the boiler-house and machinery hall, showing the location of every boiler and engine, each being numbered. The key to these numbers is given on the bottom of the blueprint. A brass peg is screwed into each spot occupied by a boiler or engine. At one corner are stacks of red, white and black tags about ½ in. wide and 2 ins. long. A white tag hung on a peg indicates that that particular engine or boiler is working; a red tag shows that the boiler or engine is hot and ready to be put in operation at a moment's notice; black shows that the engine or boiler is not in use for some reason. Whenever an engine or boiler is started or stopped the foreman on duty goes to the diagram and hangs a suitably colored tag on the peg which stands for that engine or boiler. Thus the record is constantly kept up to date. On the second blueprint is a diagram of the headers and header valves with similar pegs and tags. Whenever a request is made for steam for an engine the foreman in charge sends the valve man to open the valve and hangs a white tag on the proper peg to show that it is open. In changing watches the foreman coming on duty can see at a glance just how things stand. This saves a vast amount of labor in making out lengthy reports at the end of each watch.

An elaborate record is kept in the boiler-room showing when each boiler is started up, when shut down, when valves are opened and when closed, the steam pressure, furnaces that smoke, repairs made, and so on.

Steam Engines of the Power Plant.

The great display of steam engines was referred to in our issue of July 13, and we are indebted to Mr. Charles F. Foster, Mechanical Engineer, for the following table of engines comprising the power plant. Mr. Foster states that the list will remain as given, with the possible exception of there being an additional 150-HP. or 400-HP. engine. The list includes about 60 engines, some 10 of which are of foreign construction, one of these being of 1,000 HP. The most powerful engine is the 2,000-HP. quadruple expansion condensing engine, built by the E. P. Allis Co., of Milwaukee, Wis. There are other engines of 1,000 HP. and at the bottom of the list is a compound engine of 40 HP. There are about 18 simple engines, 34 compound, 6 triple-expansion and 1 quadruple expansion engine. The total power is as follows:

	Indic. H. P. Max. econ.	Indic. H. P. Max. load.
Total of figures given	20,668	21,232
Approx. total of all engines	24,168	26,752

The famous Corliss engine at the Centennial exhibition, at Philadelphia, in 1876, which was vastly more impressive to look at than any engine at Chicago, was of only 1,400 HP., and furnished practically all the power used.

A HINGED WATER-WORKS INTAKE AT JACKSON, MISS.

In our issue of June 15 an account was given of some of the difficulties which arise in connection with water-works intake pipes laid on the bed of Lake Michigan, including the filling or partial filling of the intakes with sand. Referring to the above article, Mr. Wm. F. Wilcox, Superintendent of the Light, Heat & Water Co. of Jackson, Miss., sends us the following interesting and pertinent matter:

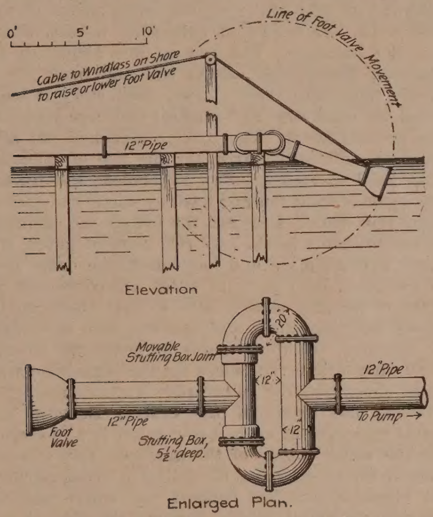
I send a sketch showing how I have arranged my 12-in. intake. If any of my fellow superintendents can use my plan I shall be happy

TABLE OF ENGINES IN THE POWER PLANT AT THE WORLD'S COLUMBIAN EXPOSITION.

Builders.	Type of engine.	Hor. vert.	Cylinders. Ins.	Ind. HP. max. economy.	Ind. HP. max. load.	Driv. pulley. Diam. face. Ins. Ins.	Speed.	Size steam pipe.	Size ex. pipe.	Weight engine. Lbs.	Foundations. Cu. ft. brickwork. Lbs.	Foundations. Cu. ft. concrete. Lbs.	Total weight. Lbs.	Machine driven.	Connection.
E. P. Allis & Co., Milwaukee, Wis.	Quad. exp. condensing	F.	24 & 40 & 60 & 70 × 72	2,000	3,000	360 × 76	60	10	22	650,000	....	....	......	2 Westinghouse incand. dyn.	2 belts tandem.
Fraser & Chalmers, Chicago, Ill.	4-cyl. trip. exp. cond.	"	20 & 34 & 2-34 × 60	1,000	1,250	28 × 68	64½	7	16	260,000	10,800	1,773	1,508,760	1 " " "	Belt.
McIntosh, Seymour & Co., Auburn, N. Y.	Double tand. comp. cond.	"	18 & 32 × 36 double	1,000	1,500	16 × 78	112	7	14	250,000	3,150	2,700	702,000	1 " " "	"
Buckeye Engine Co., Salem, O.	4-cyl. trip. exp. cond.	"	20 & 0 & 2-36 × 48	1,000	1,300	20 × 75	85	8	12	120,000	5,274.3	5,476.8	1,410,120	1 " " "	"
Atlas Engine Works, Indianapolis, Ind.	Compound condensing	"	14 & 24 × 30	1,000	1,300	12 × 75	150	5	8	114,000	4,913.3	1,268.1	741.768	1 " " "	"
Westingh'se, Church, Kerr & Co., Pittsburg, Pa.	Comp. cond., 6 engines	V.	21½ & 37 × 22	1.000	....	132 × 14	200	10	14	(195,000 eng. & dyn.)		9,266.4	1,111,968	1 " " "	Direct con.
" " " "	" " 2 "		18 & 30 × 16	350	....	8 × 26	250	8	10	......	656.5	1,000	198,780	1 " " "	Belt.
" " " "	" " 3 "		12 & 20 × 12	125	....	65 × 9	300	5	7	(23,000 eng. & dyn.)		1,282.6	153,912	1 Exciter	Direct con.
Russell & Co., Massillon, O.	Double tand. comp. cond.	H.	15 & 24 × 24	506	897	10 × 60	125	7	12	83,298	1,398	1,412	217,200	12 50-light standard arc dynamo.	Counter shaft.
" " "	Tandem comp. cond.	"	13 & 20½ × 20	216	384	7 × 30	180	5	8	29,898	699	730	171.480	4 " " " "	" "
Atlas Engine Works, Indianapolis, Ind.	Tandem comp. cond.		14 & 21 × 30	500	650	12 × 36	150	5	8	57,000	2,130	318.9	293.868	10 " T. H. " "	" "
Bass Foundry & Mach. Wks. Ft. Wayne, Ind.	Cross compound cond.	"	16 & 30 × 42	224	440	16 × 43	70	5	10	61,000	1,935.5	1,393	471,520	6 " Excelsior " "	" "
Lane & Bodley Co., Cincinnati, O.	" "	"	16 & 30 × 42	300	350	16 × 43	70	5	10	80,000	1,871	1,680	426,120	6 " T. H. " "	" "
" "	Tandem compound cond.	"	16 & 28 × 42	300	350	18 × 36	80	5	10	75,000	1,061	1,196.4	270,888	4 " " " "	" "
" "	Simple	"	18 × 42	150	200	14 × 25	80	5	6	37,000	963.4	764	205,240	3 " " " "	" "
Watertown Engine Co., Watertown, N. Y.	Double tand. comp. cond.	"	9 & 16 × 14	250	....	60 × 12	250	4½	10	21,200	702	1,316	242,160	4 " West. Elec. " "	Belt direct.
Buckeye Engine Co., Salem, O.	Cross compound cond.	"	14 & 28 × 24	300	360	10 × 33	50	......	......	33,000	1,361	1,324	322,080	6 60-light Ft. Wayne arc dyn.	Counter shaft.
" "	Tandem compound	"	11 & 21 × 16	150	190	76 × 26	215	......	......	25,000	1,142	1,049	262,920	1 150-HP. Ft. Wayne generator.	Belt direct.
" "	Simple	"	16⅛ × 30	190	250	13 × 25	110	......	......	23,000	700	1,156	222,720	4 60 light Ft. Wayne arc dyn.	Counter shaft.
" "	"	"	13 × 21	125	175	80 × 12	175	......	......	14,000	630	1,079	205,080	2 " " "	Belt direct.
" "	"	"	13 × 16	125	175	64 × 12	225	......	......	15,000	320	832	138,240	2 " " "	" "
Ball & Wood Co., Elizabeth, N. J.	Cross compound	"	14 & 22 × 12	200	250	66 ×	280	5	8	......	705	1,065	212,400	4 " Brush "	" "
" "	Tandem compound	"	13 & 20 × 16	150	200	78 ×	226	5	8	......	512	715	146,040	3 " " "	
" "	" "	"	"	"	"	"	"	"	"	......	512	715	146,040	3 " " "	......
" "	Simple	"	16 × 16	"	"	"	"	6	7	......	405.5	665	128,460	3 " " "	" "
" "	"	"		"	"	"	"	"	"	......	405.5	665	128,460	3 " " "	" "
Russell & Co., Massillon, O.	"	"	17 × 21	....	....	108 × 20	150	"	"	......	900	......	......	1 150-HP. Western Elec. gen.	" "
" "	"	"	13 × 18	....	....	2-72 × 12	....	5	5	......	600	......	......	2 50-light Western Elec. arc dyn.	" "
Erie City Iron Works, Erie, Pa.	"	"	15 × 14	225	290	2-60 × 10½	275	5	6	18,000	350	581	111,720	3 " " " "	" "
N. Y. Safety St. Power Co., New York, N. Y.	"	"	15¼ × 16	150	200	72 × 12	250	4½	6	......	273	600	104,760	3 " " " "	" "
Erie City Iron Works, Erie, Pa.	"	"	15 × 14	225	290	2-60 × 11	275	5	6	18,000	350	581	......	4 " Standard "	" "
Schichau, Germany	Triple exp. condensing	V.	57 × 37 & 23 × 27	1,000	....	....	100	......	......	......	......	......	....	1 Siemens & Halske 1,000-lt. arc.	Direct connected.
Stearns Manufacturing Co., Erie, Pa.	Tandem comp. cond.	H.	19 & 31 × 24	600	800	102 × 31	165	7	12	675,000	889	620	181.080	2 225-Kw. Mather generator.	Belt direct.
" " "	" "	"	15 & 25 × 20	375	500	88 × 23	200	5	9	34,000	687	493	141,600	2 120 " " "	" "
Phœnix Iron Works Co., Meadville, Pa.	4-cyl. trip. exp. cond.	"	15 & 24 & 2-26 × 18	500	....	2-108 × 26 1-108 × 38	200	6	14	......	2,273	1,640	469,560	2 220 " Eddy "	" "
" " "	Tandem compound cond.	"	13 & 24 × 18	250	....	108 × 26	"	5	9	......	2 148	1 628	453.120	1 " " " "	" "
" " "	Simple	"	18½ × 18	"	....	98 × 26	220	7	9	......	1,801	882	201,960	1 " " " "	" "
A. L. Ide & Son, Springfield, Ill.	Tandem compound cond.	"	13 & 22 × 16	225	250	72 × 16½	245	6	8	24.000	400	763	139,560	2 80 " C. & C. "	" "
" "	Simple	"	16 × 16	200	"	"	"	"	7	18,000	374	763	136,320	2 80 " " "	" "
E. P. Allis & Co., Milwaukee, Wis.	Cross compound cond.	"	19 & 36 × 48	500	800	16 ×	90	7	12	85.000	......	8,820	1,058,400	1 500-HP. Western R. W. gen.	Direct connected.
General Electric Co., New York, N. Y.	Triple exp. condensing	V.	....	1,000	....	....	....	8	18	......	2,300	595	347,400	1 400-Kw. Edison M. P. gen.	" "
Armington & Sims Eng. Co., Providence, R. I.	Simple	H.	18 × 21	....	....	84 × 25	225	7	10	......	489	869	162,962	2 175 " " generator.	Belts direct.
Ball Engine Co., Erie, Pa.	Cross compound	"	18 & 36 × 18	480	570	86 ×	225	7	18	65,000	1,071	980	246.120	2 " " " "	" "
McEwen Manufacturing Co., Ridgway, Pa.	Tandem compound cond.	"	14 & 23 × 20	220	325	84 × 29	200	5	10	24,000	1,410	1,308	326.160	2 80 " " "	" "
Willans & Robinson, England	Comp. 3-throw engine	....	....	....	360	44 × 5	350	4	5	......	....	....	......	1 180-Kw. Siemens generator	....
Sioux City Engineering Wks., Sioux City, Ia.	Simple	H.	24 × 48	350	425	16 × 44	....	8	9	49,000	....	....	......	Line shafting	Belt direct.
Gold St. Min. Iron Wks., San Francisco, Cal.	Tandem compound	"	12 & 22 × 30	200	270	11 × 25	115	4	7½	35,000	1.305	1,264	308,280	" "	" "
Edw. P. Allis Co., Milwaukee, Wis.	Compound	V.	16 & 26 × 16	225	....	100 × 31	175	4	8	21,000	545	....	......	" "	" "
Bates Machine Co., Joliet, Ill.	Simple	"	20 × 48	297	346	16 × 27	60	6	7	43,000	1,458	....	......	" "	" "
Harrisb'rg F'ndry & Mach. Wks., Harrisb'rg, Pa.	Tandem compound	"	17 & 28 × 18	300	370	102 × 31	176	6	11	50,000	1,674.1	1,047.8	326.628	" "	" "
" " " "	" "	"	17 & 28 × 18	"	....	"	"	"	"	45,000	......	....		" "	" "
Providence Steam Eng. Wks., Providence, R.I.	" "	"	12 & 20 × 42	225	300	12 × 25	125	5	8	49,600	665	775	172.800	" "	" "
B. W. Payne & Sons, Elmira, N. Y.	Simple	"	15 × 20	110	150	96 × 19	150	6	7	17,000	660.5	711.2	164,604	" "	" "
Erie City Iron Works, Erie, Pa.	"	"	18 × 22	300	390	84 × 24½	160	6	7	18,000	695	530	147,000	" "	" "
Galloway Co., Limited, Manchester, England.	Compound condensing, with superposed cyls.	H.	17 & 30 × 45	350	....	23½ ×	70	......	......	......	......	....	.....	" "	Belt to co. shft. & ropes to line shft.
Willans & Robinson, England	Comp. cond., 3-throw	V.	3-14 & 20 × 8	....	360	58 × 40	350	4	5	......	....	....	......	" "	
" "	Comp. cond., single act.	"	2-12 & 17 × 8	....	165	58 × 10	380	......	......	......	....	....	......	" "	Belt.
Schichau, Germany	Triple exp. condensing	"	29½ × 19 & 12 × 14	150	....	....	150	......	......	......	....	....	......	....	"
Wolf, "	Compound condensing	H.	10¼ × 17 × 16	40	....	....	110	......	......	......	....	....	......	3 shafts by cotton rope drive	....
Grusonwerk	....	....	....	....	....	....	......	......	......	......	....	....	......	Line shaft	....

to have served them. The joint was made by R. D. Wood & Co., of Philadelphia, who still have the patterns.

My suction runs out on a bent into Pearl River, from which we take water directly. I found that with a rigid suction long enough to reach the water in the summer that during high water the suction would sand in and choke the pumps. Since putting in my present suction I have had no trouble.


0'
5'
10'
Line of Foot Valve Movement
Cable to Windlass on Shore to raise or lower Foot Valve
12" Pipe
Elevation
Movable Stuffing Box Joint
12"
12" Pipe
To Pump →
12"
Foot Valve
12" Pipe
Stuffing Box, 5½" deep.
Enlarged Plan.

Hinged Intake Pipe, Jackson, Mass.

I should think this suction might be arranged on a lake front with a cable reaching ashore to raise and lower it, the pipe from the pumps to the special being placed under the sand.

THE CHENAB RIVER BRIDGE AND TRAINING WALLS; NORTHWESTERN RAILWAY, INDIA.

(With inset.)

The railway system of India has been laid out, in the main, with a view to possible strategic purposes, and this applies particularly to the lines extending to the north and northwest frontiers, where there is liability of outbreaks among the border tribes, and also the possibility of a future invasion. For this reason the railway works include some semi-military protective or fortified works. The fortified station at Lahore, an important junction in northern India, was illustrated and described in our issue of Sept. 1, 1892, and we illustrate this week the fortified piers and abutment towers of the Sher Shah bridge of the Northwestern Railway over the Chenab River, near Moultan. It will be seen by the sketch map that the Russian railway which reaches Samarcand is comparatively near Kandahar, for military purposes, which latter city is the objective point of the Bolan Railway, referred to in our issues of March 23 and April 20. Our views on Indian railways, both as to their engineering and strategic features, have been given at some length in our issues of Aug. 4, 1892, and April 6, 1893. The bridge was designed for the requirements of the northwest frontier system of strategic railways, and connects the main line of the Northwestern Railway with the loop known as the Sind Sagar branch. The connection was constructed simultaneously with the bridge, and consists of about four miles of railway and a junction station. In the event of frontier complications the link will be a very valuable one in the new rapidly developing chain of strategic lines on the northwest frontier of India. The entrance and exit of the bridge, at the abutments, are flanked by carefully designed blockhouses, capable of defense against musketry fire during any ordinary local disturbances. The piers are all similarly defended.

We are indebted to Mr. Francis J. E. Spring, M. Inst. C. E., now Engineer in Chief of the East Coast Railway (Eng. News, April 13) for the drawings reproduced on our inset sheet (to which we have added the sketch map to explain the location of the bridge and the reason for the defensive works), and for a descriptive paper on the bridge, its foundations, and the river training works, from which we abstract the following details. The Sher Shah bridge was designed and its construction supervised by Mr. J. R. Bell, M. Inst. C. E., under whose immediate direction as Engineer in Chief the work was carried out by Mr. Spring as Resident (Executive) Engineer.

The Chenab River has a length of about 700 miles to its junction with the Indus River at Mitan Kot, from which point the combined waters flow 500 miles to the coast, emptying into the Arabian Sea near Kurrachee. The Chenab is characteristic of the great rivers of northern India. Between October and the end of May it is a comparatively gentle stream of about a third of a mile wide and 10 or 12 ft. deep, except when about January local rainfall usually causes a brief and moderate flood. From the end of May, however, until the end of September, while the Himalyan snows are melting, it becomes a broad and deep river, with velocities varying between 4 and 10 ft. per second at any part of its breadth of nearly two miles, and with a depth which from hour to hour is continually varying in the shifting and meandering channel which the water scours out for itself in the silty, micaceous and finely levigated sand of which, for a depth of from 60 to 100 ft., the bed is everywhere composed. The usual state of things is this: that the main channel, 600 to 800 ft. in width and some 40 ft. deep, may early in the flood season be found at the right bank, later on at the left bank, and toward the end of the flood season anywhere at all between the limits of a mile and a half or two miles within which it pleases it to wander. The water is laden with silt and sand scoured out of the banks and bed; and at the smallest check to its velocity through any local cause, a snag, a sunken boat, or any similar obstruction, this load of silt is dropped with great rapidity, and a shoal formed in a few hours which usually has important results upon the behavior of the river for a considerable distance up and down stream. The velocity, which is due to the fall of the country generally, some foot or so per mile, is far in excess of what the material of the bed and of the banks is able from its nature to stand, and the result is a continual diversion of the main stream from side to side and a consequent sinuous course. From this sinuosity it follows that the upper few feet of water is continually finding short cuts over the shallows, with a great increase of velocity, which results in a rapid deepening and cutting back of the lower outfall of the short cut. If the rise of the river continues long enough for this deepening and cutting back to establish itself right up across the shallow into deep water at the upper end of the bend, the usual result is that in a few hours the short cut over the shallow has itself become the main channel. This means a temporary great increase in velocity in this new section of main channel, and a consequent disturbance of the existing conditions at its upper and lower ends. It also means that the original or sinuous channel, across the chord of which the short cut has established itself, is rapidly silted up; and, after a slight fall of the river, the place, where a few days previously there may have been 40 ft. of water, is found to be dry land, for perhaps the remainder of the season. This general description of the physical conditions of the Chenab is applicable, with but slight modifications, to all the great rivers of northern India, the materials of whose beds and banks are not capable of withstanding the velocity due to the general fall of the country.

At the date of the building of the earlier bridge at Wazirabad, 300 miles farther up stream, the great width of the river, at that place about two miles, was looked upon as an inevitable evil; no attempt was therefore made to narrow it, and it was bridged, as it stood, by 64 spans of 145 ft. But in the 17 or 18 years during which this bridge has been maintained for the Northwestern Railway, it has been found possible, by attention to and the gradual and scientific development of the original training works designed by Mr. Lambert, to very greatly reduce the length of the bridge. A large number of the spans have been permanently closed, and the girders thus set free are being utilized for the re-enforcement of the remaining girders, which, originally designed for the meter gage, have during all these years been used by broad gage trains, an arrangement very detrimental to economical traffic working, as restrictions must necessarily be imposed in regard to the weight of trains and engines. The obvious remedy appeared to be to make artificial banks of coherent material, and it was clear that the precise form of these artificial banks was an important practical problem. The exponent of the artificial bank theory was Mr. J. R. Bell (Eng. News, Nov. 10, 1892), who practically applied it in the case of the bridging of the Chenab at Sher Shah.

At the place which was selected for the crossing, the untrained river was 1½ miles broad. Half of this has since been closed up, and half has been bridged by means of 17 spans of 200 ft. in the clear, resting on well foundations 75 ft. deep. The first brick was laid Sept. 1, 1893; and after 16 months' work, or on Dec. 31, 1890, the first freight train passed over the bridge. The piers, which are 212.5 ft. apart, c. to c., stand upon blocks, or wells, of a double hexagonal shape, each pier upon one such block. These wells are sunk to a depth of 77 ft. below low water, through the sandy bed of the river. Each abutment stands upon two such wells. There are thus 20 double wells in all, against the 219 single wells which were considered necessary when the river was bridged in a very similar place 20 years ago. The girders carry a railway of Indian standard gage, of 5 ft. 6 ins.; and ordinary double vehicle, pack and pedestrian traffic are accommodated on a roadway at rail level. This ordinary country traffic is passed across between the trains, under a regular signaling system, and a suitable escort. The trains are few, and the surrounding country is not densely populated. The underside of the girders is 27 ft. above low water, and the rise of flood being 13 ft. there remain 14 ft. of headway for river navigation. Experience of the Punjab rivers, upon which from time immemorial there has existed a very extensive boat traffic, proves that this height amply suffices for all the requirements of navigation. The wells, piers and abutments are of brickwork, and the girders are of steel.

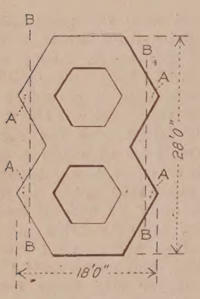
Work was practically started upon the preparation of materials in April, 1888. Brick fields were opened out, and lime was collected and burnt. About ten million brick were manufactured; they were 12 × 6 × 3 ins., and about eight of them went to a cubic foot of masonry; they cost something under $4.50 per 1,000. The lime used on the work was the small nodular "kunker," between the sizes of a pea and a cherry. This pea kunker, as it was called, was brought by rail from a distance of about 150 miles; it was then mixed with about one-third of its bulk of brick-clay, wetted and pressed into ordinary brick molds, and the resulting bricks, after being dried, were loaded into a Bull's trench kiln, and burnt as if they were ordinary bricks. The mortar was fairly quick setting, strongly hydraulic, and after about ten days in the work, but little inferior to Portland cement mortar containing five parts of sand.

The plan of the wells may be described as a double hexagon, with sides 4 ft. thick, so far overlapping at the junction that one side 4½ ft. thick is common to both; the vertical bond-rods, which run up from the curb through the masonry to the top of the wells, form on plan two perfect hexagons with a common side in the exact middle of the thickness of the masonry. The block is 28½ ft. long by 18 ft. wide, each of the outer sides of the hexagon being 9 ft. in length. The apertures left for the dredging were two hexagonal holes, 4 ft. 6 ins. on a side, in which circles 7 ft. 6 ins. diameter might have been inscribed. Each masonry well is founded upon an iron curb or shoe, which with its bond-rods weighs 9.2 tons; this curb rises 4 ft. outside and 2 ft. inside the well, is made of ¼-in. plate, and of 3 × 3 × ⅜-in. angle iron. When commencing a well the groove in the curb between the outer and inner plates was first filled with Portland cement concrete, and on this the brickwork was laid and carried up with an internal corbelling, at an angle of 30° with the vertical, until the desired thickness of 4 ft. had been attained, and thence the well was built upward to the section which has been described. After completion of the lowest or corbelled length of 9 ft. the well was alternately built and sunk in lengths of 22 ft., corresponding to the lengths of the bond-rods, until the entire length of 75 ft. had been attained. Near the top of the well the brickwork was always corbelled out on the outside, so as to give a working margin on top of the well for any accidental displacement that might have occurred in the process of sinking, and also to gain room for the device for founding the pier in deep water when a well had got overtopped by the floods.

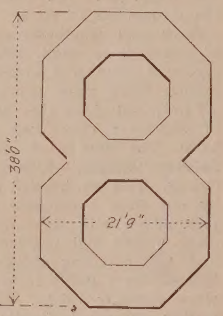
The principal feature of the well sinking was the extensive use of Mr. J. R. Bell's large dredgers, which contain 40 to 45 cu. ft. of excavated material. These dredgers were, by preference, worked from the jibs of ordinary steam traveling cranes, dismounted from their wheels, and bolted on top of the wells by means of the 1½-in. vertical bond-bolts, which, as already described, were brought right up from the curb. The adoption of this system in place of the method usually employed, in which the adjoining ground or a pontoon is used, as a basis for the dredging plant, was admirably justified when floods overtook the well sinking; during these floods the wells worked, as described, by the steam cranes thus mounted continued to be sunk, without interruption, during the rises of the river. In some cases, when the wells were sunk in water, their dredging gear was worked off floating pontoons. Of all the methods which the exigencies of each case rendered necessary no one method approached in economy, convenience or efficiency that represented on the drawing, the five-ton steam crane bolted on top of the well, there to work day and night, discharging over the side.

The time occupied in the well sinking may be summarized as follows: The last of the 20 curbs was placed in position just 14 weeks after dredging had been commenced. The briefest actual working period spent on the sinking of any one well was 28 days, and the longest 70 days. The average of all was 52 days per 75 ft. well, or nearly 18 ins. per day. There were of course great delays due to building, erection of gear, floods, accidents and other causes, so that it took in all from Sept. 5 to Aug. 3, or 333 days, to accomplish the 500 lin. ft. of sinking, or an average over the whole job of 1 ft. 6 ins. per day from start to finish. The quickest piece of sinking which can be traced in the records is 7 ft. for one well in one day; "but there were very many weary days in which wells refused to sink at all in spite of ceaseless dredging."

The well system of foundations has been extensively and successfully adopted in sandy river beds in India, and its application for dock foundations at Glasgow, Scotland, was described in our issue of June 2, 1892. Mr. Spring writes us that this system was followed at the Kistna Bridge, on the East Coast Ry., of India (Eng. News, April 13), where the foundations are of double octagon blocks 21 ft. 9 ins. × 38 ft., as shown on the accompanying cut, and sunk to a depth of 80 ft. below water level. At that bridge, too, he repeated the operation of narrowing the river by training walls, enabling him to bridge the river with 12 spans of 300 ft. He also expects sanction to carry out similar training works at the Godaveri River, narrowing it from 8,000 ft. to 5,000 ft., and bridging it with 19 spans of 250 ft. It would seem as though this system might be applicable in this country.



Chenab Bridge Well.



Kistna Bridge Well.

In a circular well the dredgers can act all round at a uniform distance from the cutting edge of the curb; but in a long or oval shaped block or well with two dredging apertures, there are two places, at the middle of the long sides, to which the dredging tool cannot approach so nearly as it can to all other parts of the periphery. There is consequently a tendency for the well to be hung up on a sort of central pair of mounds of undredged material, and to topple over in an up or down stream direction. The double polygonal form by cutting off these two undredgable places, and leaving them outside instead of inside the periphery of the curb, does away with the difficulty, and allows of equally near access for the dredger to all parts of the cutting edge of the curb. In practice, it was found on the Sher Shah bridge that there was little or no tendency for the wells to fall over in an upstream or a downstream direction. Polygonal wells, with definite corners and arrises, can be easier built straight by the native mason than circular wells; he has something definite to work to with his straight edge, and less temptation to use the plumbob when carrying up his work from a section of well already, perhaps, out of plumb.

In the author's opinion the double hexagonal form of block labors under a special disadvantage of its own, in that the small four triangular areas, marked **A** on the annexed diagram, are not very efficient in affording support to the descending well if it should show a tendency to lean over on its side; the effective breadth of such a well is perhaps fairly represented by the two dotted lines which cut off the small triangular areas marked A, and the well is, consequently, disproportionately narrow. This is merely a matter of sinking facility, and in no way effects the question of whether the actual area of double polygon is or is not sufficient for the weight which it has got to bear. As the result of experience with the Sher Shah wells the author has designed the similar blocks which form the foundations of a bridge over the Kistna River which he has recently constructed, of the double octagon form which is shown in the diagram alongside of the double hexagon; the exceedingly straight and economical sinking of the Kistna bridge wells is, in the author's opinion, largely due to this change of design.

A very tangible advantage which straight-sided wells posseses over round ones is that the straight-sided curbs can be made considerably quicker and cheaper than the round ones by the Indian mechanical engineering firms, from whom such work is usually ordered, so that a working season may not be lost in getting them out from England.

It was necessary to establish nearly half of the well foundations on sites where, notwithstanding its partial subsidence after the summer floods, the river was still running deep and strong. The usual method had heretofore been to form a ring of sandbags around the intended site of the well, and when the ring thus formed had emerged out of the water to fill it up with sand or clay fetched to site in boats. On the Sher Shah bridge the 40,000 or 50,000 cu. ft. of loose bowlders which are invariably thrown around the piers of rivers of this sort in northern India were made use of to form the necessary islands. These bowlders were deposited from boats, round the intended site of a pier, in the form of a ring with a diameter of about 50 ft.; and then after its emergence from the surface of the water, the interior circle was filled with sand, and on the island thus formed the curb was laid and building and dredging proceeded as on dry land. The rapidity and consequent cheapness of sinking the first few feet of well through the loose sandy soil of these recently formed islands in part made up for the cost of their formation.

Later on, however, the result was not altogether satisfactory; because as wells, and especially wells which are heavily corbelled on top, get down to a depth of over 50 ft., the thing that is being sunk is not only the well itself, but the well plus a circumadherent mass of sand of a more or less conical shape, extending at the top surface to a distance of perhaps 10 or 12 ft. all round the well. The result is slower and slower subsidence as the well gets deeper, and the consequent removal by the dredgers of three or four times the bulk in sand of actual well sunk. The surrounding ring of loose stone is apt to follow the subsiding mass of sand, and this stone, originally deposited in about 15 ft. of water, has more than once been taken out by the dredgers at a depth of between 60 and 70 ft.

The gain in time, however, which results from the rapid commencement of all the wells in the quickly formed stone ringed islands, will, in the author's opinion, usually justify resort to this expedient for the founding of wells in moderately deep and rapid water, in preference to the construction of high and expensive iron caissons. In illustration, however, of how difficult it is to safely lay down rules in a matter of this sort the author mentions that, owing to the impossibility of procuring the large number of boats that are necessary for the formation of such islands, he has at the Kistna bridge used iron caissons, floated into position, for those wells which had to be founded in deep water.

The object of filling the wells is to add to their weight and stability, in anticipation of deep scour occurring around them. The complete filling up of the space at the bottom inside the curb is a matter requiring careful attention. In the Sher Shah bridge a plug 10 ft. high of Portland cement concrete was formed by lowering the concrete in self-tipping bags all round the edge of the dredging holes, in the hope of its finding its own way beneath the offsetting at the bottom. Above the bottom plug of cement concrete the wells were filled with broken brick ballast to within 10 ft. of the top, when the remainder was pumped out dry, and concrete composed of brick ballast and mortar was carefully rammed in layers up to the top of the well. Some of the earlier Indian bridges have concrete filling right through from below, but the thickness of their well walls is only 3 or 3¼ ft., while that of the Sher Shah bridge wells is 4 ft., which is more than amply sufficient to carry the weight of the superstructure. The abutment is carried upon two wells, as shown.

The tops of the piers are surrounded by loopholed parapets to which access is given by a flight of steps descending at each side from the roadway. The abutment wells were carried up far above water, 15 ft. higher than the pier wells, though sunk to the same depth. This extra height of well is concealed by the training works embankment. On the front of the pair of abutment wells the half of an ordinary pier carries the ends of the last girders. In the same mass of masonry as this front half pier, but receding back from it, and splayed outward as they stand on the outer halves of the two wells, are a pair of defensible towers, flanking the entrance. The towers are about 15 ft. diameter inside, and strong rail and brick floors divide them into three stories, each story is loopholed for musketry, and a spiral staircase connects the several floors. The roof is corbelled out into an area sufficiently large for the use of machine guns, and is appropriately loop-holed; the towers are entered from the rail level by small and strong plate iron doors. Between the towers the entrance of the bridge is blocked by two pairs of gates; the inner pair of plate and loop-holed, the outer pair of bar iron; both pairs of gates are connected by a set of parallel motion bars so that they can be closed simultaneously, and they can then be strongly fastened. In these times of peace the towers form appropriate residences for the signalmen who have charge of the telegraphic arrangements for working the traffic of the bridge. Beneath the spiral staircase in each tower there is a reservoir for the water supply of the garrison; this was arranged for by finishing the filling of these particular blocks a few feet beneath low water, and by providing a small culvert through the side of the block before sinking it. All water thus passing into the reservoir will have been filtered through the sand on its way from the river.

The girders are 206 ft. span from center to center of bearings, and weigh inclusive of bearings 219 tons per span. They were designed by Sir Alexander Rendel, and the design is one which admirably lent itself to speedy erection. Girder erecting began on April 10, and all the spans were erected by the end of 1890. All the girders were erected in place on their bearings, on a simple system of staging formed of 12-in. square timber braced with old double headed rails. The water spans were piled to carry this staging, and the pieces of girder were lifted into place by means of Scotch cranes with 60 ft. jibs standing upon floating pontoons. In one case a pontoon took a whole girder on board in pieces, and having been floated into place handed up the pieces to the erectors; but it was usually found more convenient to send the pieces out by country boats alongside of the pontoon containing the crane. Such of the girders as were over the dry river bed were erected by derricks. When erection work began it took 12 days to prepare a span of girders for the riveters; but the last two girders were erected ready for riveting, and all joints made and service bolted, in 4½ days and 4 days of nine working hours; in the last case the pieces of girder were passed along on trollies over the top, and were lifted from the trollies into place by the floating crane.

Toward the end of the girder erection some 5,000 men were employed upon the bridge. A large percentage of these men had been previously employed on one or more of the many large bridges which during the past 20 years had been constructed in northern India. With great gangs of labor careful design in the first place is very important; it insures that the grade will easily come together; as with a girder ill designed, in this respect the increased cost of erection may easily run to 4 or 5 lbs. per ton in excess of the cost of erecting the well designed girder. The way to erect economically is to get the several gangs of men to compete with one another, and this is a thing which the natives of northern India will always do if properly handled.

The truss diagram represents the girder covered by the test train consisting of two ten-wheel engines weighing with their tenders 163,520 lbs., 44 ft. over buffers, and the rest of the span covered with freight cars 22 ft. over buffers and weighing 40,320 lbs. (18 gross tons). Under this test the girder exhibited a maximum deflection of 13-16 in. of which 9-16 remained as a permanent set. The maximum oscillation with the same train and speed of between 25 and 30 miles an hour was ⅜ in. for the top chord and 3-16 in. for the bottom. One span when tested for oscillation, by running a crowd of men over it, gave a deflection of 3-16 in. and a sway of ⅛ in. When the maximum loads that are ever likely to run over it are brought to bear upon the bridge the stresses will be about 6.5 tons in compression and 7 tons in tension, in the main girders. In the cross girders the compressional and tensional stresses may be 3.75 and 4.25 tons respectively. The rail bearer stresses are about 4.7 tons per sq. in.

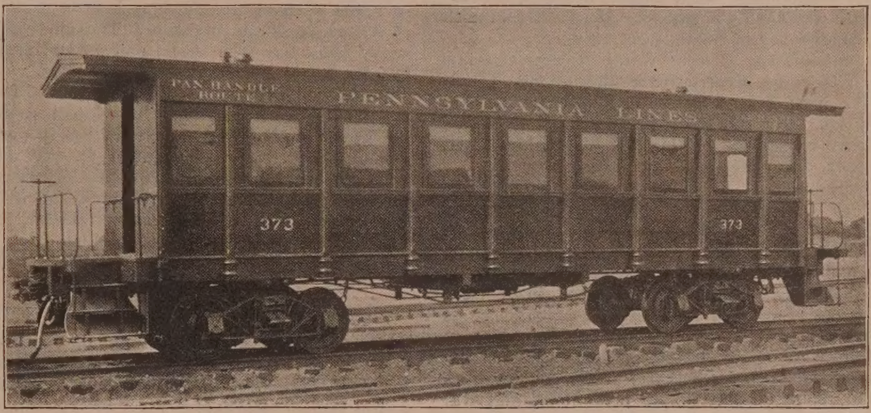
While the banks are 8,000 ft. apart the bridge is only 3,600 ft. long. As the result of years of careful study of rivers of the class of the Chenab, it appeared that to narrow it at the site of the projected bridge all that was necessary was to fix upon the site and length of the bridge, boldly dam up the rest of the river, which in the working season would usually be dry sand, and then construct substantial embankments running for a considerable distance up stream, at right angles to the line of bridge, at either abutment, allotting to each embankment the necessary amount of loose stone along its river face to protect it from erosion. All along the front line of the intended embankment, which was to form the core, a trench was dug out in the dry season 60 ft. wide, and of such a depth that, owing to percolation at lowest water level, the digging could go no further. The sand which was dug out of this trench was put into the embankment alongside, and when the latter had been brought up to a level of 3 ft. above highest flood all along its top it and the inner side of the trench were dressed off to a common slope of 2 to 1. The top of the embankment was simultaneously leveled off 20 ft. wide, and its rear side also sloped 2 to 1, and then railway tracks were laid down on the top of the embankment, and along the outer edge of the 60-ft. trench. Stone was then brought in by train, at the rate of from 2,000 to 8,000 cu. ft. per day, from quarries situated some 200 miles away. The stone thus brought was laid horizontally in the trench and at 2 to 1 all up the slope, and piled up 10 ft. in width on the top of the outer edge of the bank. It was laid from 3 to 4 ft. thick over all. The stone cost $1.25 per cu. yd. in place.

The author would like to convey to those who have not seen the process in actual work a clear idea of this system of loose stone pitching, which has been so successfully applied by Mr. J. R. Bell for the defence of the long, smooth guiding banks which he has submitted for the earlier spurs. The system may be illustrated thus: Suppose a river known to habitually scour out its bed in places to a depth of, say, 30 ft. below low water, and that it can never be predicated where such scour will occur. Then suppose that an engineer, with infinitely powerful appliances, pumps out the section of a river to be treated, and digs the whole of it out to a uniform depth of 50 ft., slopes off the sides at 2 to 1, faces them with a layer of loose stone of a sort which he knows cannot be moved individually by direct impact of the stream; and then filling in all again to former bed level, removes his infinite pumping appliances, and lets the river flow as before. The now trained river may scour its worst, 50 ft. in this case by hypothesis, but can never any longer erode its banks. The ordinary engineer being unfortunately limited as to the capacity of his pumps can only slope his banks, and pitch his slopes, down to low-water level, and, perhaps, two or three feet deeper; so he places the remainder of his loose pitching horizontally, in continuation of that on the slope, and when, sooner or later, the river commences to dig and scour beneath this horizontal pitching the latter falls in, and in the long run automatically forms the desired slope down to the limit of depth of possible scour.

It will be useful to see how far the expenditure of so large a sum as $160,000 in narrowing the river was justified by the saving thereby effected in the cost of the bridge. The length of the bridge being 3,656 ft., its cost per lin. ft. was about $111. The entire breadth of the river between its permanent banks was about 8,000 ft., so that by narrowing the river a saving was effected of 4,300 lin. ft. of bridging at $111 per foot, or $478,000, by an expediture of $160,000, so that by the system of training adopted there was effected a net saving of $318,000.

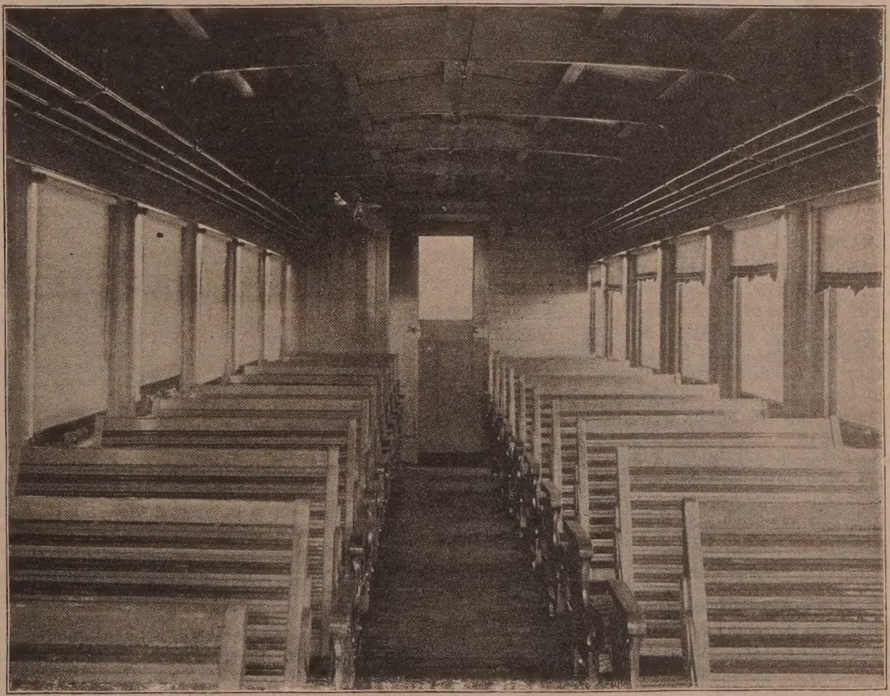
EXCURSION CAR FOR WORLD'S COLUMBIAN EXPOSITION TRAFFIC; PENNSYLVANIA CO.

The requirements of the heavy but temporary traffic in connection with the World's Columbian Exposition has led some railways to devise special forms of passenger cars which may be readily converted into other types of car after the Exposition traffic has ended. The Illinois Central R. R. had a number of cars built for its special local or rapid transit service between the city and the Exposition grounds, which can be converted into fruit or refrigerator cars (Eng. News, Nov. 17, 1892, and May 4, 1893). The Chicago & Northern Pacific R. R. and the Baltimore & Ohio R. R. have a number of cars for special excursion traffic, which can be utilized as suburban or summer excursion cars, or converted into box cars (Eng. News, June 8). The officers of the Pennsylvania Lines West of Pittsburg have designed for their cheap excursion traffic a special car which is practically a gondola car with passenger car superstructure, and we are indebted to Mr. S. P. Bush, Acting Superintendent of Motive Power, for the accompanying illustrations and description.



SPECIAL EXCURSION CAR FOR WORLD'S COLUMBIAN EXPOSITION TRAFFIC; PENNSYLVANIA LINES.

This type of excursion car is 41 ft. 10 ins. long over all, 33 ft. 1½ ins. long inside; 9 ft. 9 ins. wide over all, and 8 ft. 4 ins. wide inside. The car is practically a standard gondola car converted into a passenger car by means of a superstructure. The side stakes used on the ordinary gondola are extended to the proper height and support the side plate on which the carlines rest. A double board roof, provided with ventilators, is used, the under side of the roof and the carlines being finished to form the ceiling. The ends of the gondola are removed and in their place corner and door posts are put in, forming the skeleton of a regular passenger car end. Narrow panels are introduced on each side of the stakes, which form the posts, and are arranged to receive the window sash in such a way that they can be raised to the regular height for passenger car windows. The sash is of quartered oak, and is the standard for first class cars, being provided with plate glass 29 × 25½ ins. The platform and steps are a modification of the company's standard passenger car platform, being made somewhat longer in order to facilitate handling passengers. They are provided with standard Janney couplers.



INTERIOR OF SPECIAL EXCURSION CAR; PENNSYLVANIA LINES.

The cars are equipped with the latest Westinghouse quick-action air-brake and train air signal. The interior is painted in light tints, giving the cars a clean and cheerful appearance. A basket rack of ample dimensions, extending the whole length of the car on either side, affords a large and convenient receptacle for lunch baskets and parcels of all kinds. The cars have a seating capacity for 50 persons. The seats are of the Hale & Kilburn pattern with reversible backs and tilting cushions. The cushions and backs are composed of thin flexible wooden slats mounted on canvas, and are provided with standard seat springs, making an entirely comfortable seat. Each car is provided with a closet, drinking water tank, etc., and all the special appliances introduced in regular passenger cars are brought into use, making these cars practically as safe and comfortable as the regular passenger equipment. The cars are mounted on the standard iron freight trucks, which have been provided with regular passenger car springs.

U OF I
LIBRARY

NOTES FROM RECENT WATER-WORKS REPORTS.

A net gain of 258 meters was made at Providence, R. I., in the quarter ending March 31, 1893. During the quarter the use of only three meters was discontinued, and only seven old meters were replaced by new ones. There are now in use 11,166 meters, against 16,661 services. The make and size of the meters in use at Providence at the close of 1892 were given in our issue of April 20, 1893. The average daily consumption of water for the quarter was 8,967,456 gallons. Mr. Robt. E. Smith is commissioner of public works.

In anticipation of clear water at New Orleans, which is to be secured by a filtering plant built by the New York Filter Co., and soon to be in operation, the water company has placed meters on its large consumers. In his last report, Mr. L. H. Gardner, Superintendent, states that:

"The prospects of a clear water supply give promise of avoidance of the guesswork assessment plan, which has never been satisfactory, either to the company or the consumer. Heretofore our muddy water cut and wore out meters in a remarkably short space of time. With clear water the life of a meter will be as great here as elsewhere.

"Large consumers are taking kindly and cordially to the system, and whether it increases revenues or not, it will insure waste prevention, and will place your company on the list of those who, by the meter system, have improved their financial record in a marked manner. This is the history of the meter system everywhere.

TESTS OF ROLLED BEAMS OF BESSEMER BASIC STEEL.

Some experiments were lately made at the Glengarnock Iron & Steel Works, on beams rolled from Bessemer basic steel. The tests were made by a distributed load of pig iron, on a clear span of 15 ft., suspended by 1-in. rods and saddles from the beam itself. The dimensions of the beams and the results of the test are given as follows by our English contemporary, "Industries," in a late issue.

Material.	Size. In.	Web. In.	Weight per ft. run. Lbs.	Span. Ft.	Material. Ultimate tensile strength per sq. in. Tons.	Material. Elongation 8 in. per cent.	Load distributed on failure. Tons.	Stress in flanges at failure per sq. in. Tons.
Bessemer basic steel	12 × 6 × ¾	$\frac{9}{16}$	54	15	29.6	25.5	50	21 (A)
Do.	10 × 6 × ⅝	½	42	15	27.7	24.0	34½	21 (B)

Both joists on collapsing turned over and bent with an easy radius until the ends were nearly at right angles to each other. No flaw in any flange.

(A) Deflection at 50 tons distributed = 1 in. on removal of load recovered to ⅛ in , the load having remained on 18 hours. On joist being again loaded, as 50 tons was reached, collapse took place.
(B) Deflection at 34½ tons just before collapse = 2½ in.

A STEEL 150-TON PILLAR CRANE.

A 150-ton crane has been placed on Finnieston Quay, in Glasgow, and officially tested by lifting a load of 150 tons of steel rails 20 ft. high and making a complete revolution with this load. This steam pillar crane was built by Cowans, Sheldon & Co., of Carlisle. The framing, shafting and jib are made of mild steel; the gearing is generally cast steel and the rollers and pathway are of the latter metal.

The center is a casting of nine tons held down by six steel bolts, each 38 ft. 9 ins. long and 5 ins. in diameter. The six washer plates are each 6 ft. square, and are built into the masonry of the seat at a depth of 30 ft. In this center casting is the 17-in. center pin weighing six tons. The diameter of the roller path is 33 ft., and it weighs 12 tons. In the live roller ring are 75 cast steel rollers, with a maximum diameter of 14 ins. and an aggregate weight of 10½ tons. The frame is 27 ft. high and weighs 50 tons, and carries a boiler, 14 × 6 ft., weighing six tons.

The jib is made of two tubes each 3 ft. 3 ins. in diameter at the center and 90 ft. long. Including the stays it weighs 45 tons, and its extreme height above the quay level is 110 ft. The center of the 5¼-ft. jib head pulleys, for heavy loads, is 100 ft. above the quay; for light loads a 2½-ft. pulley is used, and the height for this 107½-ft. above the quay. The single tension rods are 10 × 2¾ ins., and the double tension rods 10 × 1½ ins., and the pins are 8 ins. in diameter. In the ballast box are 100 tons of iron and steel punchings, and exclusive of this back balance the crane weighs 270 tons in working order.

The crane has two speeds for heavy lifts, 130 and 60 tons, and two for light loads of 20 and 8 tons, respectively; there are also two speeds for revolving the crane. The lifting and lowering ropes are made of plow steel wire. Eight 2½-in., 7-strand rope take the heavy lifts; the six strands of patent steel are wound around one strand of soft steel, with the outer six taking the strain. The light loads are taken by a double 1¼-in. rope of seven strands, arranged as before, each made of 37 wires .06 in. diameter. The gin block for heavy work has four 5¼-ft. pulleys and measures 12 × 7 × 3 ft. and weighs about 7 tons.

The radius of sweep for heavy lifts is 65 ft., and for light lifts 69 ft. 9 ins. In a late test the 60-ton load was lifted at the rate of 8.8 ft. per minute and the 130-ton load at 4 ft. per minute. A complete revolution was made with the former load in 2 minutes 17 seconds, and with the heavier load in 5 minutes. The total cost, including the masonry seat, was a little less than $80,000.

COST OF A 1,500-LB. PILE-DRIVER.

In a paper read at the fifth annual convention of the Iowa Society of Civil Engineers and Surveyors, Mr. J. C. Sheely, of Des Moines, in discussing the cost of pile-driving, says that for local jobs a driver with leads 6 × 6 ins. and 30 ft. long is very convenient and will last for two or three seasons with a 1,500-lb. hammer. He gives for this driver the following bill of materials and cost:

Leads,	2 pieces	6 × 6 ins. × 30 ft.
Footpieces,	2 "	8 × 8 ins. × 6 ft.
Ladder,	2 "	3 × 4 ins. × 33 ft.
Stiff-leg,	1 "	6 × 6 ins. × 12 ft.
Side arms,	2 "	3 × 4 ins. × 24 ft.
Ladder steps		2 × 4 ins. × 35 ft.
Various braces		4 × 6 ins. × 36 ft.
Headblock,	1 piece	5 × 8 ins. × 30 ins.

At $18 per M, this lumber would cost $10.75. Three men, at $2.25 each, can build this driver in one day, say, $6.75. The hardware would cost about $2.50 and the hammer $30 to $40. The total cost is thus $50 to $60.

PERSONALS.

Mr. D. A. B. Bailey, formerly Superintendent of Water-Works at Findlay, O., died July 11.

Mr. E. M. Capps has been appointed City Engineer of San Diego, Cal., vice Gen. Thomas Sedgwick.

Mr. S. Petschcovsky, a Russian engineer connected with the Siberian Railway, is visiting this country.

Mr. Lincoln C. Heywood has been elected Town Engineer of Lincoln, R. I., and is to pay particular attention to the highway department.

Mr. Martin Kelly has resigned his position as Vice-President of the Fire and Police Commissioners, Memphis, Tenn., and has been elected Street Commissioner.

Mr. Friedrich A. Krupp, of the great German steel works, is visiting Pittsburg, where he will remain for a week or more while on his way to the Chicago Exposition.

Mr. S. L. Schoonmaker, formerly eastern representative of the H. C. Frick Coke Co., has been appointed Second Vice-President of the Carnegie Steel Co., of Pittsburg, Pa.

Mr. C. E. Shaff, General Superintendent of the Peoria & Pekin Union R. R., has been appointed Assistant to the President of the Cleveland, Cincinnati, Chicago & St. Louis Ry.

Mr. Julius Pitzman, President of Pitzman's Co. of Surveyors and Engineers, St. Louis, Mo., has been appointed consulting engineer for the improvement of the City Park, at Little Rock, Ark.

Major Niles Meriwether, M. Am. Soc. C. E., who has been City Engineer at Memphis, Tenn., for 14 years, resigned July 1, and Mr. A. T. Bell, Assistant City Engineer, has been appointed Acting City Engineer.

Baron von Doemming, chief engineer of the improvement of the Elbe River, Germany, is in this country, having been commissioned by the government to examine the system of locks and dams on the Kanawha River.

Mr. Charles Brenneke, who died recently at Marshalltown, Ia., at the age of 79, was born in Heidelberg, Germany, in 1814. He built the first railway out of Berlin. He also built the long bridge at Harper's Ferry, Va. He has been a resident of this country since 1854.

Mr. B. Haskell, Division Master Mechanic of the Northern Pacific R. R., at Missoula, Mont., has accepted the position of Superintendent of Motive Power and Rolling Stock of the Chicago & West Michigan R. R. and Detroit, Lansing & Northern R. R., with headquarters at Grand Rapids, Mich., vice Mr. W. S. Morris, resigned.

NEW PUBLICATIONS.

SEWAGE PURIFICATION IN AMERICA: A description of the Municipal Sewage Purification Plants in the United States and Canada. By M. N. Baker, Associate Editor Engineering News. New York: Engineering News Pub. Co. Pamph., 12mo; pp. 196; 79 cuts and index. $1.

As this is one of our own publications, we refrain from making extended notice of it, merely attempting to give some idea of the contents of the book, which can best be done by quoting from the prefaec, as follows:

> All who have not closely watched the progress of sewage purification in this country will doubtless be surprised to learn that the sewage of about 30 municipalities in the United States and Canada is now purified to a greater or less extent.
>
> Most of the sewage purification plants in use have been built within the last five years, and in the next five it is probable that a yet greater number will be erected. The subject of sewage purification being comparatively new, the demand for information relating to it is accordingly great, especially for the facts regarding plants actually in operation.
>
> To meet this demnd, or more properly that part directly relating to descriptions of plants in operation, the information contained in the following pages has been gathered, mainly by personal visits to the different works described, and correspondence with the engineers who designed the plants or the officials now in charge of them.
>
> The descriptions are all reprinted from Engineering News of the past year, after careful revision and a classification by the system of purification employed.
>
> It is believed that the articles will be appreciated in their present compact form, even by those who have read them from week to week in Engineering News, while for those who have not the files of that journal this is practically the only form in which the complete series of articles can be secured.

In addition to the above it may be stated that the sewage purification plants described in this little book include types of intermittent filtration, broad irrigation, sub-surface disposal, sedimentation, mechanical separation and chemical precipitation systems, which comprise all the most promising methods of treatment now in use abroad.

FOREST INFLUENCES.—Meteorological Observations; Relation of Forests to Climate and Water Supply; Sanitary Significance of Forests; Measurement of Rainfall, etc. By B. E. Fernow, M. W. Harrington, C. Abbe and G. E. Curtiss. Pub. Doc. 8vo; pp. 197.

Within the range of its subject this is an exceedingly complete report, and highly creditable to its authors and the Department of Agriculture. It consists largely of a detailed summary, with very numerous diagrams of the results of European investigations, chiefly in France, Germany, Sweden and Austria, and within its range we judge it to be one of the most complete publications on the subject in any language, and containing the pith of them all. Unfortunately, its range is limited. It contents itself with presenting facts. It does not attempt to formulate the practical lessons to be drawn from these facts, except that there is an evident leaning in faver of increasing forest areas as much as possible, with which conclusion few will differ. We do not discover that the reports bring forward many new and unfamiliar facts is regard to forests, but what they do do is to afford the basis for exact statement as to many facts usually stated only in a general way. As a scientific document, therefore, the report has great value, and anyone interested in its general subject cannot but peruse it with interest as well as preserve it for reference.

THE LOCOMOTIVE CATECHISM.—Containing Nearly 1,300 Questions and Answers Concerning Designing and Constructing, Repairing and Running Various Kinds of Locomotive Engines. By Robert Grimshaw, M. E., New York, Norman W. Henley & Co.: London, E. & F. N. Spon. Cloth; 12mo; pp. 362; 178 cuts; 5 plates; good index. Price, $2.

This catechism is intended to supply examination questions, and to instruct enginemen, firemen and learners. It is, therefore, of an essentially practical character, not only describing the different parts and appliances of the engine, and explaining their operation, but giving instruction as to the handling of an engine in ordinary service and in emergencies, and also instruction as to repair work, etc. The information is complete and is brought up to date, several pages being given to compound locomotives. The illustrations are generally good, but those of the different types of locomotives are very poor. The cut of express engine with pony trucks, while correct as to arrangement of wheels, represents a double end small suburban engine. In the description of these types no mention is made of the use of ten-wheel engines except for freight service, although they are very extensively used in fast heavy passenger service. The type is large and clearly printed, and the index occupies 16 pages.

THE YOSEMITE, ALASKA AND THE YELLOWSTONE. By William H. Wiley and Sara King Wiley. Reprinted from "Engineering," London, offices of "Engineering"; New York: John Wiley & Sons. 4to; 230 pp.; many illustrations. $3.00.

To the readers of "Engineering" for the last year or more this work will need no introduction, and one of its authors, at least, is well known to engineers in the United States, either personally or through the medium of the publications emanating from the house of which he is the chief. The work itself is a chatty, well illustrated account of the famous trip of 11,000 miles made by about 40 members of the American Society of Mechanical Engineers, in 1892, through the region described. With the details of the scenes treated, many American readers are already familiar, though they would doubtless derive further pleasure from the very lively manner in which the authors tell their story. The book is beautifully printed and profusely illustrated by half-tone reproductions of photographs, and Mr. James Dredge, editor of "Engineering," has written a concise general description of the states visited as an introduction to Mr. Wiley's more detailed treatment.

CHOLERA: Its Causes, Symptoms, Pathology and Treatment. By Roberts Bartholow, M. D., LL. D., Emeritus Professor of Materia Medica, General Therapeutics and Hygiene in the Jefferson Medical College of Philadelphia. Philadelphia: Lea Bros. & Co. 12mo; pp. 127; 9 illustrations. Price, $1.25.

The first chapter of this little book gives a very brief history of cholera, treating principally of the epidemics of 1832, 1848, 1866 and 1892. The second chapter is on the "Etiology or Causes of Cholera," and discusses the sanitary condition of Mecca, the hotbed of the disease, and of some other cities; the chapter also treats of the influence of climate, elevation, water supply and sex on the disease and describes the cholera bacillus. The remainder of the volume relates to the symptoms, pathology and treatment of cholera.

TRADE PUBLICATIONS.

GEAR LIST.—Walker Mfg. Co., Cleveland, O. Cloth; 8vo; pp. 312; illustrated. Price, $1.

This is the company's new catalogue of its special manufactures in machine molded gear, etc., and has 232 pages of tables of spur, bevel, miter, mortise and other gearing. There are also a paper on "Walker's System of Gearing," tables of useful information, and particulars of pulleys, etc., for transmission of power by ropes. About 50 pages are devoted to fac-similes of testimonials.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Engineering Congress.—There will be no meeting of the society in convention this year; all papers will be presented to Section A of the Congress of Engineering, at Chicago, which is under the charge of the American Society of Civil Engineers. The business meeting, for members only, will be held Wednesday, Aug. 2.

The following is the list of papers to be considered at the Congress by Section A:

Navigation Works Executed in France from 1876 to 1891, by M. F. Guillain.

Common Roads, Railways and River Communications in Portugal, by F. A. Pimental.

The Rearrangement of the Railway Terminal System at Altona (Prussia), with Special Reference to the Avoidance of Grade Crossings, by R. Caeser.

The Continuous Superstructure of the Memphis Bridge, by Geo. S. Morison.

The Enlargement and Improvement of the North Sea Canal of Holland (Amsterdam Ship Canal), by A. E. Kempees.

Notes on Projects for the North Sea Canal from 1629-1893, by A. Huet.

On the Manufacture and Testing of Portland Cement, by Henry Faija.

The Testing of Portland Cement and the Development of the Cement Industry in Germany, by Max Gary.

Bridge Substructure and Foundations in Nova Scotia, by Martin Murphy.

Improved Method of Constructing Foundations Under Water by Forcing Cement into Loose Sand or Gravel by Means of Air Pressure, by Fr. Neukirch.

Topographic Surveys, by Herbert G. Ogden.

Terrestrial Magnetism in North America, by Chas. A. Schott.

Historical Notes upon Ancient and Modern Surveying and Surveying Instruments, by H. D. Hoskold.

Fundamental Units of Measure, by T. C. Mendenhall, Supt. U. S. C. S.

Recent Experience on the U. S. Coast and Geodetic Survey in the Use of Long Steel Tapes, by R. S. Woodward.

The Treatment of Metals for Structural Purposes, by James Christie.

Use of Basic Mild Steel as Material for Construction in Germany, by C. Weyrich.

A Proposed Method of Testing Structural Steel, by Alfred E. Hunt.

Use of Mild Steel for Engineering Structures, by George C. Mehrtens.

American Grain Elevators, by E. Lee Heidenreich.

Manufacture and Use of Paving Brick, by Daniel W. Mead.

Carbon and Its Uses in Electrical Engineering, by Clarence M. Barber.

Inland Transportation, by Capt. F. A. Mahan, U. S. A.

Improvement of Harbors on the South Atlantic Coast of the United States, by William Murray Black, U. S. A.

Electric Light Plant of Guadalajara, by Rafael M. de Arozarena.

Practical and Esthetic Considerations in the Laying Out of Cities, by F. Stubben.

The Relative Merits of Working Hoisting Machinery by Steam, Water and Electricity, by George A. Goodwin.

On the Gages of Railway Track in General, with Special Consideration of Narrow Gage Railways, by E. A. Ziffer.

Transmission of Power in Operating Cable Railways, by Robert Gillham.

A New Method of Calculating Cross-Sections of Roads and Railroads, by Francisco da Silva Ribeiro.

Distinctive Features and Advantages of American Locomotive Practice, by D. L. Barnes.

Railway Signaling, by G. Kecker.

Surveys for Railway Location, by F. A. Gelbcke.

History of the Conversion of the River Clyde Into a Navigable Waterway and the Progress of Glasgow Harbor from Its Commencement to the Present Day, by James Deas.

The Limits Attainable in Improving the Navigability of Rivers by Means of Regulation, by H. Engels.

Development of Quay Cranes in the Port of Hamburg, by Chr. Nehls.

Plant of Maritime Commercial Ports of France, by H. Despres.

Railways in New South Wales, by Thomas F. Birrell.

Study for Railways from Guadalajara to the Pacific Ocean, by S. V. Pascal.

Railways of Mexico, by E. Prieto Basave.

Rearrangement of the Railway System at Cologne, by F. Lohse.

Comparison of Modern Engine Loading with Standard Specifications for Spans from 10 to 200 Ft., by C. D. Purdon.

A Brief Account of the Building of Leixoes Harbor, by Alfonzo J. N. Soares.

Description of the Lower Weser and Its Improvement, by L. Franzius.

Method Used to Secure the Stability of a Quay Wall at the Port of Altona, on the Elbe, in Germany, Which Had Shifted Its Position After Completion, by Berthold Stahl.

Purification of Sewage and of Water by Filtration, by Hiram F. Mills.

Sewerage System of Milwaukee, and the Milwaukee River Flushing Works, by G. H. Benzenberg.

Experience Had During the Last Twenty-five Years with Water-Works Having an Underground Source of Supply, by B. Salbach.

Some Questions Concerning the Filtration of Water, by W. Kummel.

Possibility of Increasing the Water Supply from the Soil for Purposes of Irrigation, and of Augmenting the Flow of Rivers, by G. H. Otto Volger.

On the Distribution of Water in the City of Mexico, by L. Salazar.

In addition to the above the following papers have also been received and will be presented by title:

Calculation of Railway Bridge Stresses, by John L. P. O'Hanly.

Tequixquiac Tunnel, by Louis Espinoza.

New Railway Stations in Dresden, by C. Kopcke and O. Klette.

Sewerage and Drainage of the Town of Coimbra, by J. C. da Costa, J. da C. Couraca and J. F. de M. Bessa.

Improvement of the Harbor of Lisbon, by J. J. de Mattos.

A Method of Making Mountain Railways Economical, by Ugo Baldini.

Determination of Uniform Methods for Testing Building and Construction Materials, by J. Bauschinger.

The North and East Sea Ship Canal—History and Construction, Commercial and Military Aspects; The Baltic Lock; The Sand Dams in the Burg-Kudensee Lowlands, by Mr. Fulscher, Chief Executive Engineer.

The Best Form of Level Book, by A. T. Walmisley.

A tally of the nationality of the authors (details of which we omit) shows that out of the 52 papers to be read only 18 are by U. S. Americans (11 by members of the Am. Soc. C. E.). Of the remaining 34, 16 are from Germany, 4 each from Great Britain and Mexico, 2 each from France, Holland and Portugal, and 1 each from Canada, Scandinavia and Brazil, with 1 unknown. The 8 papers to be read by title only show about the same distribution.

Saturday, Aug. 5.—Closing Session; joint meeting of all the Sections of the Congress at 10 a. m.; general reception by the General Committee of Engineering Societies at Headquarters, 10 Van Buren St., at 8 p. m. All are cordially invited to be present.

F. Collingwood, Secy.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the regular meeting June 20, Mr. M. J. Becker, President, in the chair, two important papers were read and ordered printed for discussion at the September meeting: "Gas and Gas Producers," Walter E. Koch; and "The Effects of Suddenly Applied Loads Upon the Tensile Strength and Other Physical Properties of Wrought Iron and Steel," E. D. Estrada.

At the meeting of the Chemical Section on June 27 Mr. Jas. O. Handy read a paper on "Moisture Determination in Dynamite" and one on "Notes on Phosphorus Determination." Prof. F. C. Phillips spoke of the use of natural gas in many chemical processes. Mr. R. B. Carnahan, Jr., described rapid precipitation by passing air instead of shaking. He also related instances of failure in phosphorus determination in pig iron, which were apparently due to the incomplete action of permanganate of potassium or to the precipitation of silica with the molybdate.

COMING TECHNICAL MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
July 28. Secy., C. H. McLeod, Montreal, P. Q.

AMERICAN INSTITUTE OF MINING ENGINEERS.
July 31 to Aug. 5. Chicago, Ill. Secy., R. W. Raymond, 13 Burling Slip, New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. Collingwood, 127 East 23d St., New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. R. Hutton, 12 W. 31st St., New York.

WESTERN SOCIETY OF ENGINEERS.
Aug. 2. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.

ENGINEERS' CLUB OF ST. LOUIS.
Aug. 2. Secy., Arthur Thacher, Odd Fellows' Building.

ENGINEERS' CLUB OF MINNEAPOLIS.
Aug. 3. Secy., E. Nexsen, 504 Kasota Block.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Aug. 4. Secy., E. K. Smoot, 808 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 4. Secy., O. Von Geldern, 719 Market St., San Francisco.

SWEDISH ENGINEERS' CLUB.
Aug. 5. Secy., P. Valentine. At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.

NORTHWEST RAILROAD CLUB.
Aug. 8. Secy., W. D. Crosman. Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Aug. 8. Secy., D. W. McMorris, Burke Block, Seattle, Wash.

DENVER SOCIETY OF CIVIL ENGINEERS.
Aug. 8. Secy., F. E. King, Jacobson Block.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Aug. 9. Wichita, Kan.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 10. Secy., F. W. Mowbray, Norton Building.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Aug. 11. Secy., D. W. Meeker, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Aug. 12. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
Aug. 14. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
Aug. 14. Secy., M F. Schinke, City Hall.

COLUMBIAN ENGINEERING SOCIETY.
Aug. 15. Secy., F. W. Hart, Washington, D. C.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Aug. 15. Secy., R. H. Clark, Pittsburg.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Aug. 17. Secy., C. F. Franson, Portland Block.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Aug. 18. 201 Washington Building.

ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Sept. 5. Secy., W. Halliburton.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Sept. 12. Secy., F. C. Osborn, Case Library Bldg.

NEW ENGLAND RAILROAD CLUB.
Sept. 13. Secy. F. M Curtis, O. C. R. R., Boston.

ENGINEERING ASSOCIATION OF THE SOUTH.
Sept. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.

WESTERN RAILWAY CLUB.
Sept. 19. Secy., Clement F. Street, Chicago.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 20. Secy., L. V. Carmalt, Roanoke, Va.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., S. E. Tinkham, 36 Broomfield St.

NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.

ENGINEERS' CLUB OF CINCINNATI.
Sept. 21. Secy., J. F. Wilson, 24 W. 4th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept. 21. Secy., S. A. Charpiot, Macon, Ga.

CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 7. Secy., L. F. Rondinella, 1122 Girard St.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York City,
as Second Class Matter

VOL. XXX. THURSDAY, JULY 20, 1893.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, C. S. HILL } ASSOCIATE EDITORS
GEO. H. FROST..........................BUSINESS MANAGER

Chicago Office: Monadnock Building.
F. A. PECKHAM..................................MANAGER

EUROPEAN AGENCIES.
KEGAN PAUL, TRENCH, TRUEBNER & CO. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & CO (Limited). St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES: One year, $5.00; *6 months,* $2.50; *4 months,* $2.0); *single copies 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. They should send both the old and the new addresses. No club rates are allowed.*

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES: 20 *cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering Headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

The announcement is made this week that work is for the present wholly suspended on the Nicaragua Canal, beyond care of the property, owing to lack of funds. The blame for this result is laid to the existing financial stringency, and not unreasonably; but whether or not it is possible for any private canal company to raise $100,000,000 in view of the disrepute into which the Panama and Manchester fiascos have brought all such projects, is still an unsolved problem, with the chances rather against it, we fear, until the financial horizon has become clear again, not only from temporary depressions which are to be expected from time to time, but from the chronic uncertainty resulting from the silver status. Some of our readers seem to fancy that doubts as to the technical merits of the project are one of the disturbing factors, among others a correspondent who sends us a long defense of its technical features, partly in response to the letter which appeared in our issue of the 6th inst. We do not publish this letter because it merely repeats facts which have already been fully given in these columns, and we do not consider that the project needs any technical defense. Probably no great engineering work was ever inaugurated which was not critised more or less both in good faith and bad faith, and the Nicaragua Canal project has been no exception to this rule; but few have been less criticised technically, and none, perhaps, have been better able to stand it. We fear there is little chance of Congress doing anything to encourage the construction of the canal at the coming session, in view of the many other questions pressing for action and the existing financial status, both public and private. But it is only a question of time when it will do so, in our judgment, and then the technical objections to the project will be answered in the most effective way possible.

For the benefit of those of our readers who expect to attend the Congress of Engineering, in Chicago, we call attention to the fact that the meeting of the Mechanical Section, on Tuesday morning, Aug. 1, will be devoted largely to the report of the committee of the American Society of Mechanical Engineers, on "Standard Tests and Methods of Testing Materials." Prof. A. Martens, Director of Royal Prussian Testing Laboratories, at Charlottenburg, Berlin, has been deputed to represent the well known German conferences, while Prof. Paul Debray is representing the French Government officially on this occasion. A number of other European engineers are also expected to be present, and it seems a particularly opportune moment to give methods of testing materials an international character, which will not soon recur. We hope there will be a large attendance and a profitable discussion.

Judging from the queries sent us there is evidently some slight misunderstanding among engineers as to the statements issued by the Forestry Bureau of the Department of Agriculture concerning the relative strength and durability of boxed and unboxed long-leaf pine timber; that is, timber that has been bled for turpentine as compared with the natural and unbled tree. The current opinion formerly was that the boxing injured the timber and it was not accepted, nominally, by many engineers in their specifications. The tests conducted by Prof. J. B. Johnson, of the government testing laboratory, show that bleeding in no wise injures the lumber so far as its strength qualities are concerned. In fact, as the bleeding process concentrates the resinous matter in the butt end of the tree and adds about 2 lbs. per cu. ft. to its weight, the tests show timber cut from the butt to be about 7% stronger than timber cut from the butts of unbled or natural trees.

As to the relative durability of bled and unbled long-leaf pine, the answers received to the queries sent out by the Bureau were unsatisfactory and contradictory. From all the data available the Forestry Bureau finds, however, that lumbermen are agreed upon the following important points: That a large part of the yellow or long-leaf pine sent to the market is cut from bled trees; that this bled timber is never kept apart or distinguished from the unbled timber by millers and dealers; and finally, that there is no infallible method by which one can be distinguished from the other after it is cut. Careful examinations in the laboratory and in the field do not confirm any of the opinions advanced by dealers as to the ultimate effect of bleeding on strength and durability. Some of the most resinous logs tested were from turpentine orchards in South Carolina; while some of the driest logs were from unbled forests in Alabama. The ordinary "fat streak" and "light wood," so often referred to as results of bleeding are found both in bled and unbled timber, and are usually the results of some natural wound. Weight and color are more dependent on the proportion of spring and summer wood than upon the amount of resin, except in "lightwood," and none of these features will serve as distinctions or guides as to quality. The Bureau says that the harm which follows bleeding does not lie in injury to the timber, but consists in bleeding trees too small for the mill and in wasting future lumber by stunting the growth of the trees. While tests have not been carried far enough to admit of positive and complete conclusions, the Bureau says that enough is known to show that trees that have been tapped still contain very much turpentine in the heartwood, and trees that have not been tapped at all do not necessarily contain more turpentine in the heartwood than tapped trees. It is thus safe to conclude that bled yellow pine is quite as safe and durable for all structural use as the unbled or natural tree; and this verdict is especially gratifying in the face of the general opinion that even an expert cannot tell one timber from the other when it comes to the market.

We have lately called attention in these columns to the remarkable fact that few, if any, of the heads of our engineering schools have, before becoming such, earned a distinguished standing among practicing engineers, and that a large majority of them have never been practicing engineers at all, or only in a very subordinate way. A publication which reaches our table this week illustrates this fact in a striking way by a biography of the head of one of our newer engineering schools, which we condense as follows:

> Born in 1860; early life spent upon the farm. Attended district school from 6 until 19, when he began teaching in the common schools. Attended and completed business course in —— University in 1881, then began the regular college work and graduated in 1885, with the degree of A. B. From 1885 to 1887, Adjunct Professor of Mathematics and Literature. During the following year he occupied the chair of Mathematics pro tem., and in 1888 became head of the Engineering Department. He received his C. E. degree in 1890.

Is it any wonder that college degrees of C. E. are held in light esteem, in view of such a record? Is it not natural that our engineering schools should fall short of what they might be as well as not, when so many engineering schools are officered in this way? What would become of our medical schools if it were rather the rule than the exception that their presidents and faculties had had hardly any experience in medical practice, and many of them none at all? When engineering schools are as old an institution as medical schools, this will not be so; and when it ceases to be so, engineering schools will be in several ways different from what they are, we apprehend, more effective and less purely scholastic.

We do not forget that young colleges of small means cannot be too particular, and we have reason to believe that this particular one promises to be a very live institution, and that its head, whose biography we have given, is a notably zealous and capable man. But a significant fact is that it should be deemed possible to start engineering schools in this way, and that current example should warrant it.

The official tests of armor-plate and armor-piercing projectiles made at Indian Head within the week are peculiarly gratifying to the people of the United States. While these tests have been given in detail elsewhere in this journal the summary of results would stand about as follows: The 12-in., 850-lb. Carpenter shells, made in Reading, Pa., were fired through a Creusot plate, completely wrecking it, with so little material injury to the shells that they could have been used again by simply replacing the firing band. When we consider that no armor-piercing shells were produced in the United States until within a very few years, the fact that we can now manufacture them of a large caliber and equal to, if not superior to, the best imported from abroad, is very creditable to the American makers of ordnance material. The plate trials were quite as satisfactory, though these plates were nickel-steel, not Harveyized. The 9-in. Carnegie plate was attacked by an 8-in. gun at a range of 58 ft. with Holtzer shells, the best made in Europe. With velocities of 1,400 ft.-sec. and 1,536 ft.-sec. the plate was penetrated but the shots did not get through the backing. With a velocity of 1,683 ft.-sec. the shot passed through both plate and target, but the important feature of the test was that there were no cracks in the plate after the three shots. In the third test a 17-in. Bethlehem plate of nickel-steel, intended for the barbette armor of the "Indiana," and thus slightly curved, was attacked by a 12-in. Carpenter shell at a range of 319 ft. With a velocity of 1,322 ft.-sec. the first 850-lb. shell penetrated to a depth of 16½ ins.; the second shell, with 1,495 ft.-sec., showed a total penetration of 20 ins., and the third shot, with 1,858 ft. velocity, went clear through the plate and backing. But here again this 17-in. plate, the thickest yet made by American manufacturers, showed no cracks under the impact of the final shot which represented the enormous energy of 21,600 ft.-tons. Further than this, the Carpenter shells recovered from the first two shots were wholly uninjured, the first projectile even retaining its sharp point.

The general result may be called a stand-off between American-made armor and armor-piercing projectiles; each did its full duty, though as armor is primarily intended to keep out projectiles the Carpenter shell may be said to have had the best of it in the final round. But as against this it must be remembered that the range was very short and the fixed gun was attacking a fixed target, and the advantages were practically with the gun. What would have been the result had this nickel-steel armor also have been Harveyized, or furthur treated by an American process now adopted for all our new armor, can only be guessed at. Judging from previous trials with Harveyized plates, the third shell with all its power of penetration would not have had so easy a task. The one prominent fact remains, however, that the United States in less than ten years has made itself independent of the world in the manufacture of heavy guns, armor-plate and the projectiles for piercing heavy armor, and this point has been arrived at by radically improving upon processes which were lately accepted by Europe as very nearly approaching the maximum of possible effort in these manufactures.

◆

Mr. J. A. L. Waddell sends us the following summary of the results of a ballot on "A Proposed Compromise Standard System of Live Loads for Railway Bridges," sent out by him recently in persuance of his investigation summarized in our issue of June 1:

Total ballots issued, 284; replies, 175; making the percentage heard from 62, and that not heard from 38. Of those who replied, 28 pleaded illness or lack of time, 3 excused themselves as not being sufficiently posted, 16 were opposed to balloting and 128 sent in ballots. Of the latter 115 are in favor of the proposed "Compromise Standard" and 13 are not in favor, making the percentages for the ballot as follows:

In favor of proposed standard, 90%.
Opposed to proposed standard, 10%.

The promised diagrams of equivalent uniform loads and end shears will be issued before long.

While any ballot of this kind is to be regarded only as rudely indicative, owing to the fact that many reply without due thought, and others without dure prior study of all sides of the question, yet this ballot seems to indicate a strong preponderance of sentiment in favor of equivalent uniform loads for computing bridge strains instead of separate wheel loads. This sentiment, we are frank to say, we share, not because the change would save hundreds of engineers a good deal of numerical work (though that is a consideration), but for the much stronger reason that the assumed precision of the wheel-load computations is purely illusory; first, because the actual strains porduced by the several wheels of the given locomotive when running over the bridge at speed would not be the same as figured, nor anywhere near to them, and secondly, because there is no certainty nor probability that the particular distribution of wheel loads assumed will bear any close analogy to the actual distribution of wheel-loads of maximum stress in the near future. Therefore, the process is at best nothing more than a solemn farce, and its effect seems to us to be to encourage skinning the structures; sailing too close to the wind.

THE CONGRESS ON AERIAL NAVIGATION.

It is a notable evidence of the importance which the question of aerial navigation is assuming in the minds of many able men that it should be deemed either desirable or possible to hold a "World's Congress" of three days devoted exclusively to it. Such a congress is to be held in Chicago, on the first three days of next month, however, simultaneously with the other engineering congresses, and it is already assured that there will be a considerable attendance and more than two dozen papers, including at least one paper on 18 different specified subjects, and generally two on each.

If we search for reasons why the subject has suddenly assumed such new importance several are easily found. The first is, perhaps, that never before has there been such certainty of a market for any successful flying machine, for use for war purposes or (what is the same thing in effect and more gratifying to the pacific inventor) for preventing war. It is generally felt that any really successful machine of this kind would practically put an end to war by making it certain that war between any two countries having such appliances would simply mean Kilkenny-cat destruction, regardless of the comparative strength of the two countries in other respects.

But there is no reason to believe that either financial or philanthropic motives have had a dominating influence with any of the men who are now devoting so much attention to the problem. Their motives are rather scientific and their encoragement is found rather in two scientific advances. The first of these is the great progress which has been made in recent years in the construction of engines and motors, by which much more power can be developed from a given weight than ever before. The second is the tardy, but at last complete, recognition of the fact that the balloon in all its forms has impeded rather than advanced progress toward navigating the air, and that the only hope of real success lies in abandoning all effort to make the machine lighter than air, in part or whole, and boldly following the example of nature by making every part of it as light as possible. indeed—but heavier than air, relying for support upon the aeroplane principle, as exemplified in the bird's wings and tail, which are evidently the only support which the bird uses or needs.

To the art of navigating the air in this way, as distinguished from ballooning, the appropriate name of "aviation," or imitation of the birds, has been given. The word is not to be found in any dictionary as yet, for it was not coined until the latest great dictionary had passed the letter A, but it is a good and necessary word which our readers interested in abstract science will do well to fix in their minds, for it has come to stay. Not that success is imminent. It may be centuries yet before any real success is attained; for this reason, if no other, that all early experimenting is beset with difficulties and dangers which few care to risk for knowledge's sake. But like the quest for the North Pole (and much more than that), man sees in this problem something worth doing which has not been done, and which his reason tells him is not impossible to do, and there will be men among our countless millions who will not rest until they do it. From each successive failure something will be learned, and finally the result will be attained, we cannot doubt.

Another fact which has tended powerfully to bring this problem into its recent prominence has been a tardy but now general recognition of the fact that many, if not all birds, fly more or less by utilizing energy taken from the wind, and not from their own muscles; and that many of the best flying birds do this almost wholly, hardly using their muscles at all except to hold their wings still when extended. Singular as it may seem, the very existence of this power in any degree was for a long time denied, though every one who has lived in hot latitudes has seen the carrion crow and other birds of its type sailing around in the air for hours together without any flapping of the wings (so long as the wind was blowing) and with an air of nonchalant ease which the most careless observer who is really observing cannot mistake. That all this work of flying is done by power taken from the wind is made absolutely certain by the fact that the bird can be seen to make no muscular exertion whatever, and also by the further fact that whenever the breeze dies out the bird stops flying, or flies only by flapping its wings.

Unfortunately, few of the birds which use largely this power of "soaring," as it is now generally termed, are found on land and in cool climates, and as the students of this problem were few and far between until about a dozen years ago, and mainly European landsmen, the fact was not admitted until very lately, though it is obvious that it is one of the most encouraging facts connected with the problem, since it indicates that after the upper air (which is nearly always moving) has been once attained, the power for further flight may be taken from the air.

Even now, although the fact of soaring is admitted, the way in which it is done is not. The program for the congress says on this head: "It is now generally admitted that birds utilize the wind in soaring, but no satisfactory explanation of the performance has been given."

The present writer is unable to see why there need be any doubt as to the nature of this performance, however. It seems to him that it admits of very easy and simple explanation, and having stated privately what he now states publicly he has been asked and has agreed to present a discussion of this question at the congress, which he thinks will be generally accepted as a sufficient and true explanation of this particular part of the problem. As our readers will have the benefit of this and other discussions at the congress in due time it is unnecessary to enter into the question further now, nor is it the purpose of this article to discuss technicalities, but merely to review the "state of the art." It will be obvious, however, that if this question alone is settled at the congress it will be something of a step toward making the art of aviation a practical possibility instead of a speculative hope. But there is good reason to believe that a number of other important problems will be either settled or much advanced by the proceedings of the congress, which beyond doubt will cover an amount of information on the subject such as never was collected before.

This result will be largely due to the zealous efforts of one man, Mr. O. Chanute, chairman of the committee on this section of the Engineering Congress, and already well known to most of our readers. For some years past Mr. Chanute has given this subject great attention, and the results of his study are embodied in two treatises on the subject dealing but sparingly in questions of pure theory, but rendering the inestimable service of collecting in one volume (or two) a critical illustrated record of pretty much all the efforts in the direction of aerial navigation which have been made in the past, and they have been numbered by hundreds. Of all it may be said: "These are our failures," but what better foundation for success can be laid than a complete record of prior failures? With the problem in its present stage, it is foolish for any one to devote his life to it, or time which he cannot spare; but it has already reached the stage where, as a recreation and diversion, like the game of chess, it is well worthy the attention of thinking men. The air is the last world left for man to conquer which is within his reach, or at least, the last one left which he is not in a fair way to conquer, if he keeps on as he has begun.

Philadelphia alleyways are to be hereafter paved with an improved patent pavement when declared defective in paving or drainage. The Board of Health has issued the following specifications for laying such pavements: All alleys 5 ft. or less in width shall be excavated to the depth of 18 ins. below the lines given by the surveyor of the district, the excavation thus made to be filled to the depth of 14 ins. with clean cinders, well rammed. Upon this shall be laid a concrete, to be composed of one part of imported Portland cement (either of Hilton or Manheimer brand), three parts of clean, sharp, coarse bar sand, thoroughly mixed dry and made into a mortar with the least quantity of water and thoroughly intermixed with broken stone or approved furnace slag, in such quantity that when tamped or rammed solidly in place free mortar will rise to the surface and exhibit a depth of 3 ins. of the said concrete. Upon this concrete foundation a surface shall be laid 1 in. in thickness, composed of one part of Portland cement (Dyckerhoff or Star Stettin brands) and two parts of crushed granite to pass through a 1½-in. sieve, free of dust, with just sufficient water to make a mortar, to be thoroughly tamped solid to the lines and grade given by the surveyor of the district, and dressed with a small quantity of dryer, composed of one-half pure cement and one-half flint sand, floated over the entire surface as a finish.

The Justin high-explosive shell was experimented with lately at Sandy Hook. The ten shots fired were fairly successful; with a projectile weighing 132 lbs. and containing 7¼ lbs. of explosive gelatine, the charge was 25 lbs. of powder and an initial velocity of about 1,400 ft. sec. was noted. Nine shots were fired at an elevation of 11° in the gun, and they did very well. The tenth shot was fired with the gun in a horizontal position and the shell exploded just beyond the muzzle, but without injury to the gun. Major Clinton Comly, president of the board of ordnance at Governor's Island, says that these experiments seem to show that fired from a mortar or even from an ordinary rifle the shells will prove satisfactory; but that in firing horizontally they are not absolutely trustworthy. The projectile is made up of a steel outer case and an inside wooden case holding the gelatine and centered by two pins at the ends. The idea is that the wooden base will break the initial shock of the explosion, and the pivots will allow the wooden case to slowly take up the rotary motion due to the rifling of the gun and not develop sufficient heat to explode it. In horizontal firing there may be a slight space between the wooden cylinder and the rear plug, and this small play may cause a severe shock in firing and jam the inner cylinder and communicate rotary motion at once instead of gradually, with the result given.

A wrought iron highway bridge is to be built across the ship channel at Eleventh St., Tacoma, Wash., as noted in our news columns last week. The structure will consist of a 250-ft. swing span, with a 185-ft. fixed span at each side and an iron viaduct approach of 340 ft. at the west end. The width of the approaches will be 52 ft. over all, with a 40-ft. roadway and two 6-ft. sidewalks, and the width of the roadway on the channel spans will be 22 ft., with two 6-ft. sidewalks. The substructure will consist of five wrought iron cylinder piers. The pivot pier cylinder will be 34 ft. in diameter, filled with cement concrete, on a pile foundation. The piers for the ends of the swing span will consist of two cylinders each, 10 ft. in diameter and filled with concrete and firmly braced together. The two shore piers will consist of two 8 ft. cylinders each. The foundation bed consists of compact sand free from logs and boulders and of good bearing power. James M. Morrison, City Engineer.

The cumulative vibration of bridge trusses under a series of rhythmic impulses is made the subject of a report in the "Zeitschrift des Oesterreichsen Ingenieur und Architekten Vereine" by Prof. F. Steiner, of Prague. For a particular class of bridge, Professor Steiner finds that the period of vibration was as follows:

Span of bridge in feet....	32.8	65.6	131.2	193.8	262.4	328.1
Number of vibrations per second for loaded bridge....	6.1	4.3	3.1	2.5	2.2	1.9
Number of vibrations per second for unloaded bridge..................	15.3	8.9	5.4	3.9	3.1	2.6

Professor Steiner points out that regular recurring shocks may arise from the counterweights of the locomotive and from the rail joints, and under certain conditions these shocks may give rise to dangerous oscillation. and he concludes that there is reason to believe that the Moenchenstein disaster may have been due, at least in part, to this cause. Details of similar experiments made on highway bridges were given in our issue of May 25, 1893.

LETTERS TO THE EDITOR.

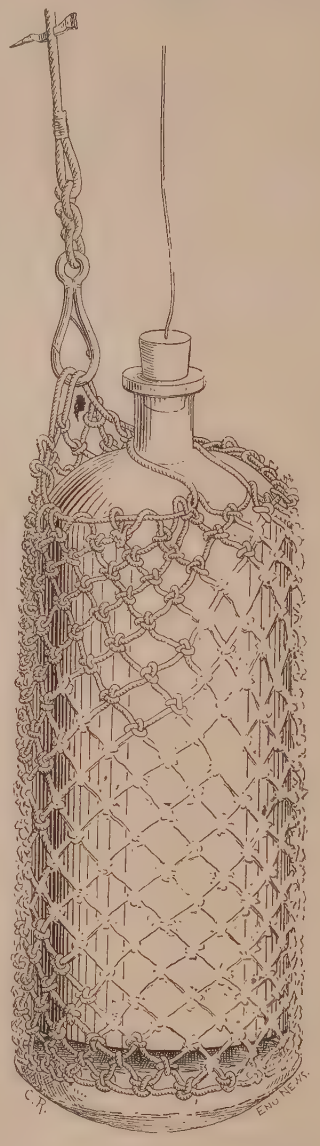
COLLECTING SAMPLES OF WATER.

Sir: I noted with some interest the sketch and description of apparatus used in collecting samples of water for analysis which appeared in your issue of May 18th, page 459, of current volume. In reference to this subject, I send you the following notes regarding the apparatus used by Dr. W. H. Ellis, of the School of Practical Science, Toronto, and myself, some years ago, in collecting from various lakes and rivers, samples for the Toronto Water-Works.

The bottles used were those termed "Winchester Quarts," and for transportation they were securely packed in wooden crates; each crate holding six bottles. All bottles were first thoroughly cleaned in the laboratory and were provided with glass stoppers. Our apparatus for obtaining the sample consisted of a network bag made of knotted twine, having a double canvas bottom filled with shot, while around the top there was a loop of twine run in, to which was attached, by a snap-hook, the line used for lowering and raising. Tags marking each foot were fastened to this line, the measurement commencing at the bottom of the bag, so that we could conveniently take the sample from any desired depth. Incidentally I might mention that we also had a registering thermometer, in order to take the temperature of the water at the same depth as that from which the sample was drawn.

The method we followed in collecting the samples was as follows: After the boat was brought to the point selected, the depth of the water was ascertained by using the weighted bag as a sounder. The thermometer was then lowered to the right depth, by its own line and allowed to remain. The bottle was then placed in the bag, a rubber stopper, having a light but strong line attached, was inserted, and all was lowered to the required depth, as shown by the marks on the line. The light line attached to the stopper was then pulled, the bottle filled and was drawn to the surface. The contents of this first bottle were always used to thoroughly rinse out the bottle and wash the permanent (glass) stopper. A second time the bottle was lowered, filled and drawn up. The glass stopper, after being washed again, with a little of the water from this second bottleful, was then inserted, covered with a piece of canvas, tied down with twine and labeled with a shipping tag. The bottle was then placed in the crate, the thermometer pulled up, the reading noted, together with any remarks regarding the appearance of the water, the shores, etc., and we were ready to move to the next point.

Cork was never used as a stopper, and sealing-wax, used by some in making fast the stopper, was not used by us on account of the probability of small particles of wax adhering to the bottle, getting into the water and vitiating the analysis. Two days was the greatest time allowed to elapse between the time of collecting the sample and the commencement of the analysis. The bag of shot, used as a sinker, I found much more convenient than a detached weight, such as shown in your sketch, and there was less likelihood of breaking the bottle. As I consider small matters of detail, such as the above, frequently of value to the engineer, I take pleasure in sending you this description together with a model of the apparatus used.



Collecting Samples of Water for Analysis

Yours truly,
T. J. McMinn.

277 Pearl St., New York, July 5, 1893.

CONCERNING IDEAL ENGINEERING EDUCATION.

Sir: Permit me, as one of many, to thank you for the series of articles which are now coming out on "Ideal Engineering Education" and I do it now, rather than later, because experience has shown me that there will be a great deal of adverse criticism aroused by them on the part of those who should know more about it; namely, the professors of the engineering schools. This I say advisedly, because I have had many conversations with them on this very subject, and have heard them criticise these views very fully.

I may say that I am a graduate of two engineering schools, one civil and one mechanical, and since graduation I have been a constant reader of Engineering News, and while I have absorbed information from many sources, that derived from that paper has been of greatest benefit to me. At the same time I feel that nothing that you have published is equal in importance to this series. The truth and justice of your remarks, and the lack of true knowledge on the part of the professers of what constitutes a proper engineering course have been well illustrated in my own case.

During the time that I was in college, there was a particularly fine opportunity to give practical instruction to all of the men, which was not taken advantage of to any appreciable extent, and as a consequence, my first engagement came very near terminating disastrously, and an opportunity to make several thousand was lost. Even so simple a matter as chaining was done in a way that would have made a country surveyor blush, and the results were less accurate than ordinary stadia work. It was in Engineering News that I derived the first hint as to the way in which better work should be done.

After becoming established in business, I took for a student a graduate of a high school, of about 18 years of age, who studied under me for about 18 months, and could then do all of the figuring in a city surveyor's practice with greater speed and accuracy than the "honor" engineering man of the year, whom I also employed and who was about 23 years of age. I suppose if I had had a long and intricate calculation for which the calculus only could have been applied, that there was some chance of the latter coming out ahead; but as it was, while he was considering whether he should use the calculus, trigonometry, or something else, the other fellow would have the problem solved. And yet when this argument is adduced against the professor, he simply says "but think what a splendid foundation he has." So he has, but as you truly remarked, he has lost hopelessly three years in getting it and can never make that time up.

It is unnecessary for me to say that I hope you will continue because, having put your hand to the plow, you are not likely to turn back until the fence on the other side is reached. But I want again to express the very high appreciation which I have for the work you are doing, and the hope that other engineers, who are equally interested will do likewise, so that whether our friends, the professors, believe it or not, they will feel constrained to pay some attention it.

With you, I have a very high appreciation of many of these professors, men who are doing a good work, who are making large sacrifices and are spending "gray matter" freely in the endeavor to benefit the profession; but they think that for that very reason they must necessarily know more of what a student should be taught than the men who subsequently have to use the student.

Yours truly,
Consulting Engineer.

New York, June 12, 1893.

COST OF LIVING AT CHICAGO.

Sir: Many persons, and undoubtedly some engineers, are remaining away from the World's Columbian Exposition during these hard times, on account of the supposed high prices reported to prevail here. In order to assist in removing this misimpression I will give the result of my own experience of a two weeks' stay, trusting that it may possibly induce some one to visit this magnificent and instructive display of human achievements who might otherwise feel compelled to remain away.

I gave my two children, boys of 19 and 14 years of age, the choice between living more economically and staying proportionately longer, or of having better accommodations and leaving sooner. They chose, very properly, the former course. We therefore searched for a room, not in a hotel, but in a private house, and found one within a block of the Exposition, on Washington Ave.—a very pleasant street. We found a large number of such opportunities within half a mile north and west of the gates. It took but an hour to find and look at half a dozen places. We pay $2.50 for our room, and might have had one across the street for $2 a day, but preferred the former because the house was new, the room on the second instead of the third floor, the bathroom neater and next to our room. One dollar a day will secure a hall room for one person in many first-class dwellings. We are getting our meals at one of the numerous available restaurants at prices varying from 35 cts. for breakfast to 50 and 75 cts. for dinner, mainly at the Woman's Baking Co.'s restaurant, within a block of our room.

The admission to the Exposition is 50 cts; children, 25 cts. We count on 50 cts. apiece for lunch at the Exposition and 50 cts. apiece for small extras. The total charges for visiting the best places of amusement, special exhibitions, etc., nearly all of which are in the Midway Plaisance, and some of which could be omitted without regret, amount to about $10. Ten days will enable anyone, who exercises a little skill and thought in properly dividing up his time, to see all the interesting exhibits. This he can therefore accomplish, without discomfort, for $45, after he has found his room and got his trunk into it, for which latter the Parmelee Co. charges 75 cts. To-day rooms are still to be had in plenty; later it may possibly take longer to find a suitable one.

Cool Waukesha spring water is served on the grounds at a great number of places for 1ct. a glass, a great boon to the thirsty during this hot weather. Sterilized lake water, not as cool, is free. Among the stronger drinks obtainable my boys voted as the best and most satisfactory on the grounds, the orange cider, as served in the Florida State Building, and in the "Plaisance," for 5 cts. a glass. The drink going by the same name but sold at the regular drinking stands, for 10 cts. a glass, we did not like. The Wellington restaurants are fair and the prices not exorbitant. The German restaurants seemed to us to give the best prepared food, but the charges were higher. Yours truly,

Chicago, Ill., July 18, 1893. M. Am. Soc. C. E.

FEES OF ENGINEERS.

Sir: There has been much said in relation to the fees of engineers and wonder expressed why so few of them ever made any considerable amount of money from purely professional work. A case has recently occurred within my knowledge which, it seems, might cast some light upon the subject. A certain town desired maps, plans, surveys, specifications and estimates for a system of sewers. The system cannot possibly be built for less than $60,000 to $75,000, if it can be built for these figures. The system required 10 to 15 miles of sewers, and a disposal plant probably. There were no accurate maps or profiles in existence, and consequently a survey and profile of each street would have to be made. The bids for this work ranged from $50 to $2,500. Out of 18 bidders 9 bid $800 or less and 7 were under $500. How can good work be done for these prices and any profit be made—even a fair salary? Some of these low prices were from engineers of considerable experience, who had never done any work in that section and who had no notes to fall back upon. They would have to go over every foot of the work with an instrument. Is it any wonder engineers do not get rich?

Yours truly, "Sewers."

New York, June 24, 1893.

RELATIVE FRICTION OF AIR AND WATER.

Sir: Please state in your next issue the latest information as to the difference of friction between a moving surface and air as compared to the same moving surface and water, assuming the pressure to be 10 lbs. per sq. in. above the atmosphere.

New York, July 15, 1893. Subscriber.

(The question is, in the first place, stated somewhat vaguely, and in the second place, if ever so precisely stated, could not be answered accurately as to either air or water, and still less comparatively. If, as we assume, our correspondent means friction proper (skin friction) as distinguished from displacement resistance, the determination of it for either air or water is beset with difficulties which have never been surmounted to our knowledge, though separate allowances are made for it in ship designing, and the greater portion of the resistance of ships is known to be caused by it. By analogy we might expect the friction of the two under otherwise equal conditions to be about as the density of the two materials or as 1 to 815, and competent authorities have laid down that the skin friction of birds in air is so small as to be a negligible quantity.—Ed.)

USE OF PLANIMETER IN RAILWAY PRACTICE.

Sir: If your correspondent at Wayne, Ill., in relation to the above subject will look up the April, 1874, number of the "Journal of the Franklin Institute" he will find an article on the measurement of earthwork by the use of the planimeter, much to the point. C.

PENNSYLVANIA MARBLE.

Sir: On my return to New York, after a month's absence, I notice in the issue of Engineering News of June 29 a reference to my tests on Avondale marble, p. 601. There were two reports made on these quarries: one—the most complete and extensive—was by Professor Koenig, of the Michigan Mining School; the other—chiefly corroborative in its nature—was by myself. The comparisons with Carrara and other foreign statuary grades are from Professor Koenig, and, while I have no doubt they are justified, I myself spoke only of the structural applications. Our tests for absorption agreed very closely and were carefully made. Both they and the crushing tests, which latter were performed in considerable number, cover the quarry quite thoroughly, and, as set forth in the full reports, indicate with all desirable fullness the quality of the available stone. I have no doubt that they are accessible to any one interested.

Very truly yours,
J. F. Kemp.

Kingston, R. I., July 14, 1893.

A NEW TELEMETER TARGET—CORRECTION.

Sir: I have read with much interest your article in Engineering News, July 13, 1893, dealing with the new telemeter target, but there is a slight error in the two last formulas.

The article gives for a horizontal distance from the transit to the target the formula:

$$\text{Distance in feet} = 11{,}278.56 \times \frac{n}{m},$$

which is correct except the figure 11,278.56; it should read 11,277.80.

For an inclined distance reduced to the horizontal the article gives the formula:

$$\text{Horizontal distance in feet} = 11{,}278.56 \times \frac{n}{m} \times \cos A,$$

A being the angle of elevation or depression.

Now this formula is not quite right. No matter if the target is with the transit telescope in the same horizontal plane or not, the transit will always measure the horizontal angle between vertical planes.

The last named formula should therefore be identically the same as the first one, no reduction to the horizontal being necessary.

Should the inclined distance be desired, it would be expressed by:

$$\text{Inclined distance in feet} = \frac{11{,}278.56}{\cos A} \times \frac{n}{m}.$$

The vertical height in feet is given in the article by:

$$\text{Vertical height} = 11{,}278.56 \times \frac{n}{m} \times \sin A.$$

It should read:

$$\text{Vertical height} = 11{,}278.56 \times \frac{n}{m} \times \tan A,$$

for the same reason as above.

Yours, very respectfully,

New York, July 17, 1893. Chas. Kesling.

(Our correspondent is entirely correct, and the article was in error in the points noted. Several other correspondents have pointed out the same error, which is admitted by the author of the article, who is well known as an expert mathematician, so that the error arose only from his inadvertence. As for ourselves, we took the article wholly on trust, seeing only that the idea was a good one, and with this correction it becomes better yet, since the fieldwork is materially simplified and made much preferable to stadia work, which requires these reductions to the horizontal. Doubtless the error arose from an assumed analogy with stadia work.—Ed.)

AIR-BRAKE EXHIBITS AT THE WORLD'S COLUMBIAN EXPOSITION.

Air-Brakes on Foreign Engines and Cars.

That America is far in advance of all other countries of the world in the development of railway brakes is so well known a fact that it hardly requires mention here. Yet the progress which Americans have made in the field compared with the progress of other countries is better realized than ever before as one studies the exhibits in the Transportation Building at the World's Columbian Exposition. Let one recall that time-honored British practice of attaching a "brake-van" loaded with pig iron to the rear of each train—a practice which strongly reminds one of that other ancient custom of placing a stone in the end of a bag to balance the meal in the other end when thrown across the horse's back—and then stand and watch these 50-car and 100-car racks of quick-action brakes, responding to the lightest touch of the engineman with such certainty and rapidity that they seem endowed with human intelligence. Truly America has learned and has nothing to learn from the other nations of the world in the science of railway brakes, and they on the other hand prove their indebtedness to the genius of Geo. Westinghouse by the exhibits which they have brought to this Exposition. But the adoption of the Westinghouse brake cannot save a railway from mistakes in the design of brake rigging. If we may judge by the foreign locomotives and cars in the Transportation Building our neighbors over the water are densely ignorant of some of the first principles governing the design and operation of brakes. For example, on all foreign cars exhibited the trainpipe makes a right angle turn upward at each end of the car and the hose is attached at the top of the vertical pipe. This means for every car in the train four right angle bends and about 7 ft. extra lengths of pipe to increase the friction of the air. Remembering that European cars are much shorter than American, the importance of this difference can be appreciated. The friction is further increased by the fact that the trainpipe is much smaller than on American cars.

The dummy coupling for keeping dust and cinders out of the hose when uncoupled appears to be seldom used abroad. With the exception of one car in the German exhibit, none of the foreign rolling stock is equipped with dummy couplings. The hose merely hangs loose or in some cases is held from swaying by a hook, but with its end left open to catch cinders and dust.

In the exhibit of French locomotives the engine shown by the Western Ry. of France has the shoes on its three parts of drivers operated by a pull rod connected to an arm on a rock shaft at the rear. This rock shaft has another arm connected by a link to a second rock shaft and the brake piston rod is connected to a slotted arm on this second rock shaft. In this country we would call such an arrangement complicated; but it is highly meritorious compared with the brake arrangements on a Paris & Orleans locomotive which stands beside it. This machine has six drivers and the brakeshoes are applied to the rear pair only, with an air cylinder on each side for each shoe. To make a bad matter worse the brakeshoes on these drivers are ¾ in. narrower than the wheel tread, so that they wear the tire just where the rail wear comes.

The other two French locomotives are designed for very fast passenger service, if we may judge from their big driving wheels. The engine exhibited by the Northern Ry. of France has 7-ft. drivers and the driver brakes are operated by hand. The locomotive of the French State Railways is equipped with Westinghouse pump, but has no driver brakes whatever.

Passing around to the German exhibits we find a six-driver compound locomotive shown by F. Schichau, with no driver brakes. The six-wheel tender behind it has a hand brake rigging with two brakeshoes to each wheel on the front and rear axles and none at all on the middle wheels. Another six-driver locomotive, shown by Henschel & Sons, of Cassel, has brakeshoes on the two rear pairs of wheels only, applied by hand. This practice of braking part of the driving wheels of a locomotive appears still more reckless in view of the very light side rods on some of these foreign engines. In fact, the side rods on all the foreign engines appear to be very much lighter than on American locomotives.

Passing to the German cars we find a beautifully finished passenger coach equipped with the Westinghouse brake and two shoes to each wheel on the end axles; the middle wheels have none at all. The firm of Zypen von der & Charlier, of Cologne, shows an iron coal car with pressed steel sides, a flat car with pressed steel side stakes and a superbly finished parlor car, intended apparently for the use of some person as good at least as a king. Not one of these cars has any brake rigging whatever, either hand or air.

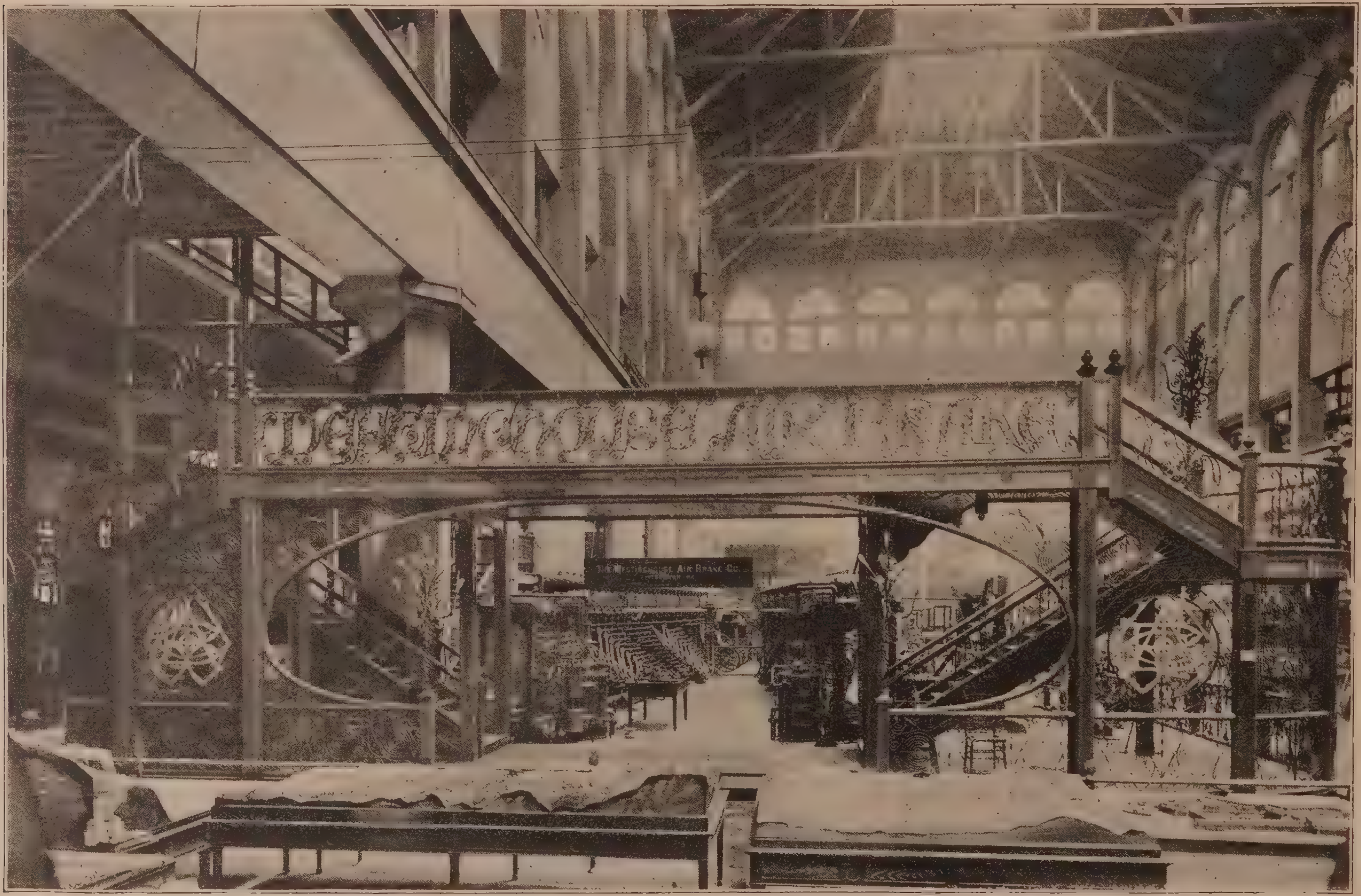
If we finish up our foreign tour by a view of Great Britain's exhibit, we find the Great Western Ry. making an elaborate exhibit of a vacuum brake, which does not have even the merit of our old Eames brake of extreme simplicity and cheapness, but uses a pump instead of an ejector and a cylinder instead of a collapsible diaphragm. But perhaps the most incomprehensible example of brake practice after all is that shown on the beautiful train of the London & Northwestern. Both of the six-wheeled coaches have brakeshoes on both sides of the wheels on the end axles, and none at all on the center wheels; and each coach has the entire apparatus of both the Westinghouse and the Webb vacuum brake. The latter is used on the English portion of the line; the former is substituted when the train runs over lines in Scotland. Notwithstanding this superabundance of power brake equipment on the cars, the brakes on the tender are worked by hand, and, queerest of all, are equipped with wooden brakeshoes. About 75% of the continuous brakes on English equipment are worked on the vacuum automatic system, and generally by means of ejectors, but the principal Scotch lines and some of the English lines use the Westinghouse brake.

In view of this showing of the most advanced types of foreign brake practice (for we may fairly assume these exhibits to be so), it is little wonder that the modern refinements of air-brake work, which are now an old story here, are quite unheard of abroad. The quick-action triple valve would hardly be appreciated in a country which after a score of years of experience cannot make up its mind whether the Westinghouse automatic brake or the vacuum is the better device.

Exhibits of American Brake Companies.

Four test racks of air-brakes are on exhibition and in pretty constant operation in the Transportation Building. The Westinghouse, Crane and Boyden companies have each a 100-car rack, and the New York Co. has a 50-car rack. In daily work, however, each company shows 50 cars only for the sake of economizing air. It is a highly amusing sight to see trimly dressed maidens, notebooks in hand, who are doing the Fair, listen with the greatest interest to the detailed explanation of the patient attendant in charge, and watch the operation and release of the brakes with an air of understanding the whole subject in all its bearings.

So far as the general public is concerned, these brake-test racks are, of course, a puzzling enigma, and those in charge of the exhibits are deserving of medals from the Society for the Reward of Patience for their constant and courteous endeavors to explain to the never-ceasing stream of visitors a subject as far beyond the comprehension of most of them as the higher mathematics. But, besides the general public there is daily a large attendance of locomotive engineers and firemen, many of whom have the first opportunity of their lives of witnessing the working of brakes on a test rack. In educating these men in air-brake science the exhibits are doing an important work.



VIEW OF EXHIBIT OF WESTINGHOUSE AIR BRAKE CO.; TRANSPORTATION BUILDING, WORLD'S COLUMBIAN EXPOSITION.

The accompanying engraving is reproduced from a photograph of the very complete and tastefully designed exhibit of the Westinghouse Air-Brake Co. Besides the 100-car rack of freight brakes, the exhibit comprises the compressed air signaling apparatus for the equipment of 12 passenger cars and a locomotive, and various types of locomotive driver brakes, exhibited by the American Brake Co. The new re-enforced brake apparatus which the Westinghouse company is just putting on the market is also shown in operation. It is described more fully below.

It was stated at the Master Car Builders' convention last month, that competitive tests of brakes would probably be carried out on these racks some time during the Exposition. So far, however, nothing has been done, so far as can be learned, toward carrying out this plan, and there are some difficulties in its way. While each of the racks is equipped with the piping corresponding to that on 50 or 100 freight cars, the length of piping differs somewhat on the different racks, and the arrangement of piping and brakes is not uniform, the exhibitors having been controlled by the necessity of getting their racks into their space in the most convenient manner. Besides this, to have competitive tests of brakes fairly comparable, they should be made on the same rack and with the same engineer's valve, the triple valves only being changed.

It is a fact which all brake experts recognize that in order to be acceptable to the railways at the present time, any new triple valve must be practically indentical with the Westinghouse in its operation, not only in its dimensions and method of actuating, but on all the details of its performance in service. About 300,000 freight cars equipped with Westinghouse brakes are now in service, and any new brake must be interchangeable with these and must work in harmony with them without in any way injuring their operation. For example, the quick-action feature of any new brake should not operate more easily than the Westinghouse, or it may operate when a service application only is desired and cause the quick-action to run through the whole train. On the other hand, the quick-action feature should not be less sensitive than the Westinghouse, or one or two cut-out cars may stop the quick-action after it has run part way through the train, and cause heavy shocks.

With the exhibition racks of the various companies operated by different engineers' valves it is difficult to get a satisfactory idea of the sensitiveness of the different triples. Perhaps as good a test as any is to observe the time required to obtain a full service application. If one brake requires much longer to go on with the service application than another, it seems reasonable to conclude that the slow brake has a triple more sensitive to the quick-action. If it were not so, would not the makers so design their engineer's valve as to get their service application more rapidly? Another test of considerable value is to note the pressure obtained and the time required in making the lightest possible service application.

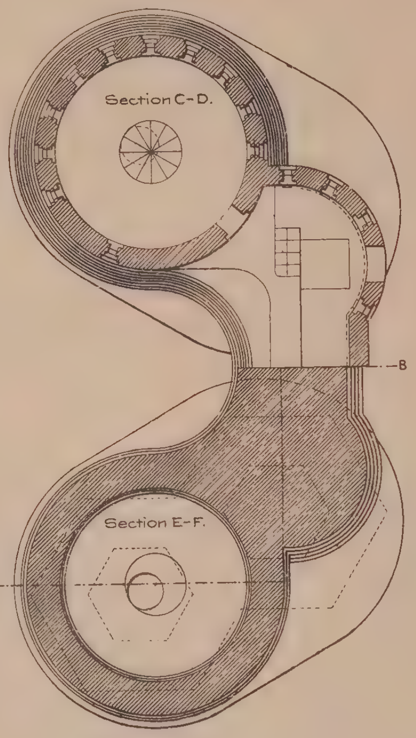
The graduation of the application is such an important matter in handling the brake that it should be carefully tested in this respect. Tests of the emergency application are much more difficult to make, with the accuracy which is essential to give them value. The looker-on cannot determine with the eye alone whether the quick-action runs through one rack more quickly than another. To make quick-action tests fairly comparable they should be made on the same rack with different triples. Release tests also can hardly be fairly made on the exhibition racks, as the brake cylinder exhausts through a sponge-filled chamber which has been applied to stop the whistling that ordinarily occurs in releasing.

Besides the rack exhibits all the companies show sectional details of the various parts of their apparatus. The New York Co. shows its new triple valve in which a slide valve takes the place of the needle valve formerly used for graduating. It also states that the size of the ports has been somewhat altered since the Karner brake tests, and that the emergency application now runs through a 50-car train as rapidly as the Westinghouse.

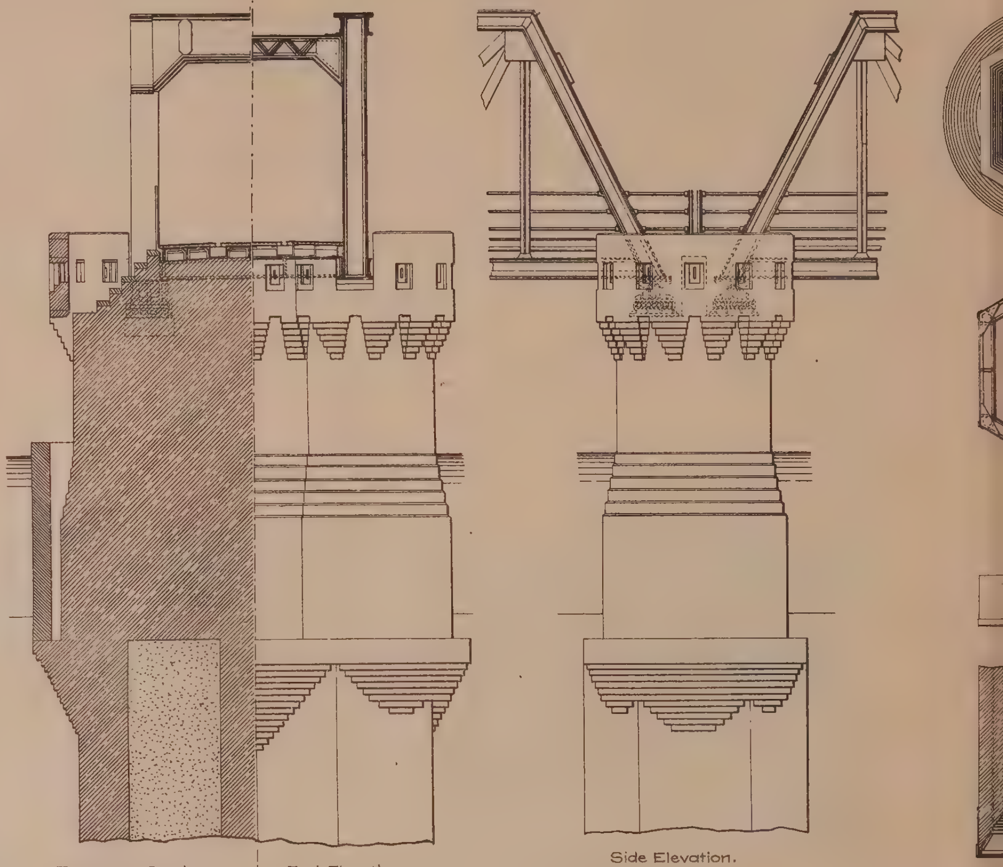
The Crane company claims for its new triple valve that in the emergency application it takes a larger proportion of air from the trainpipe into the cylinder and a less proportion from the reservoir, thus attaining a higher pressure in the cylinder and at the same time using less air from the auxiliary reservoir.

New Features in Air-Brake Practice—Devices for Varying Brake Pressure with Speed.

All the brake exhibits contain some new features of especial interest. That which is of greatest importance at the present time in view of the present tendency to very high train speeds is the re-

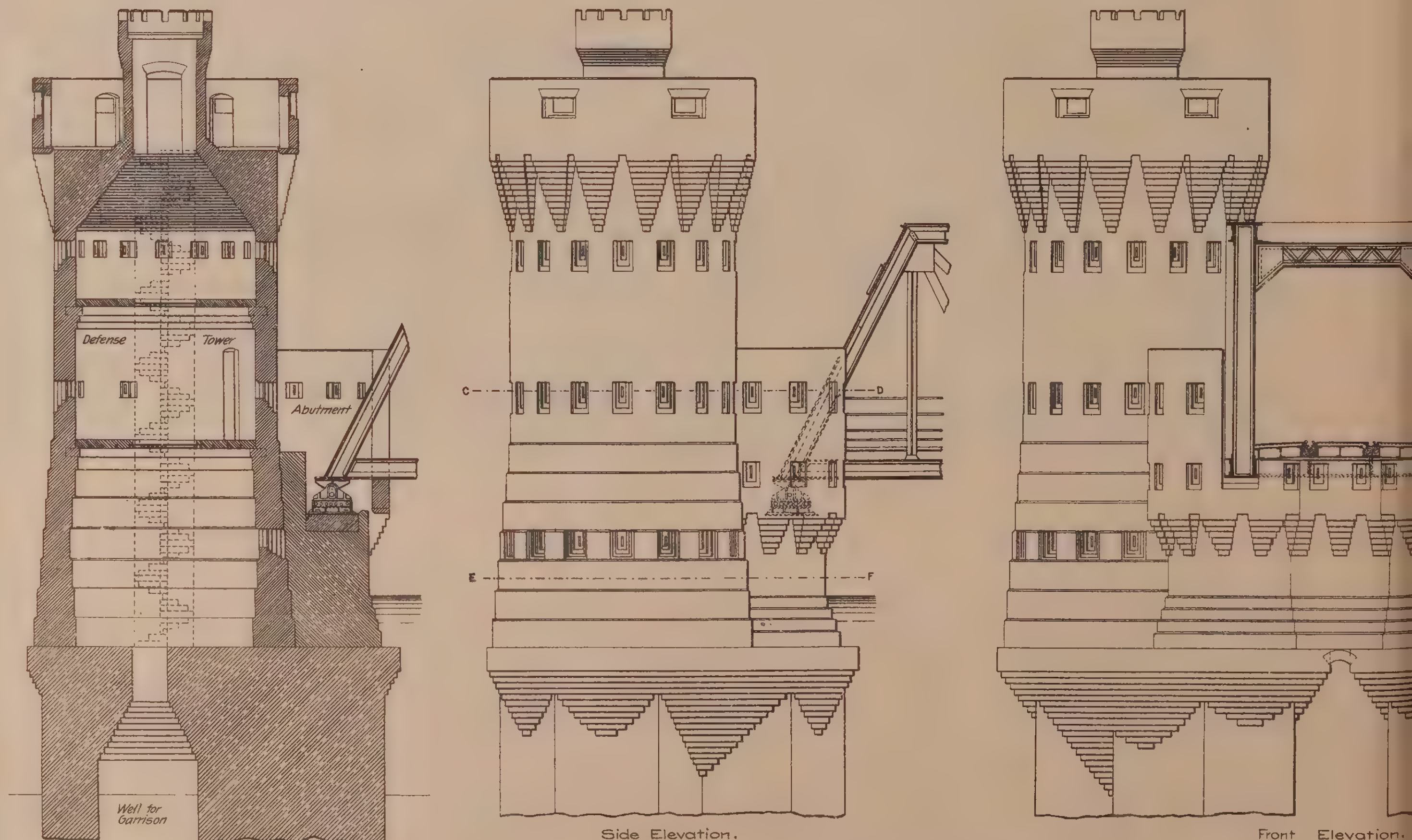


Plan of Abutment.



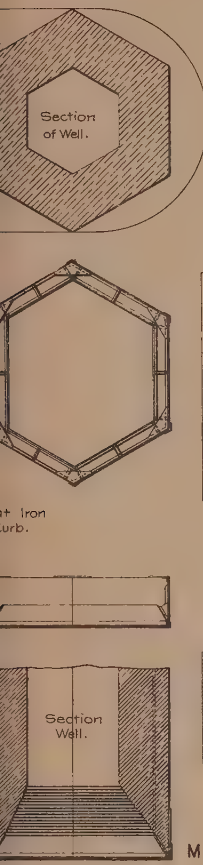
Transverse Section. End Elevation. Side Elevation.

DETAILS OF PIER.

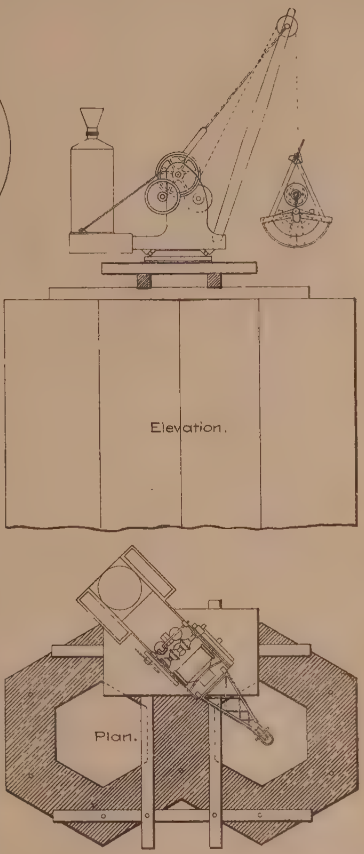


Section A-B. Side Elevation. Front Elevation.

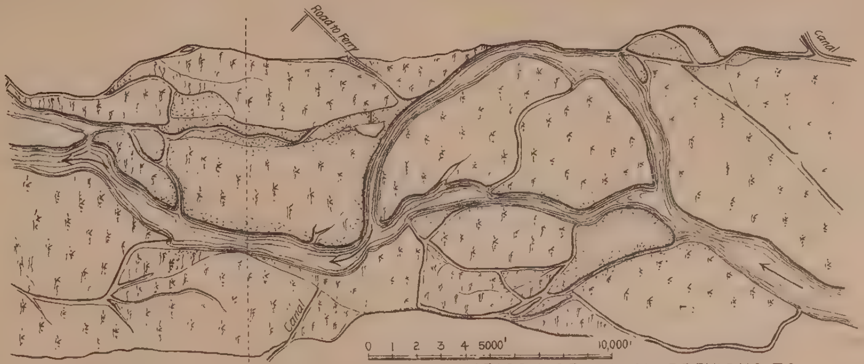
DETAILS OF ABUTMENT.



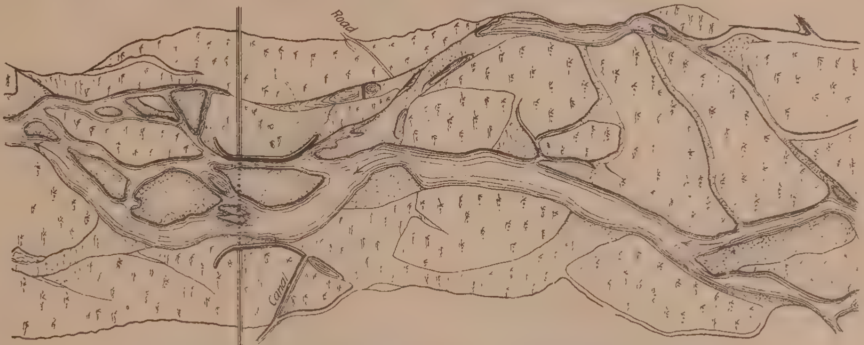
ON WELLS.



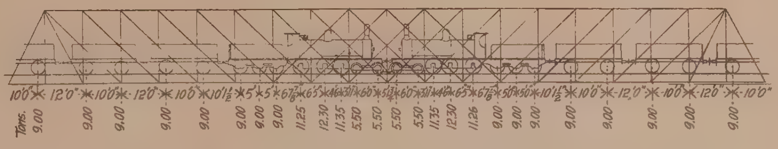
METHOD OF SINKING FOUNDATION WELLS.



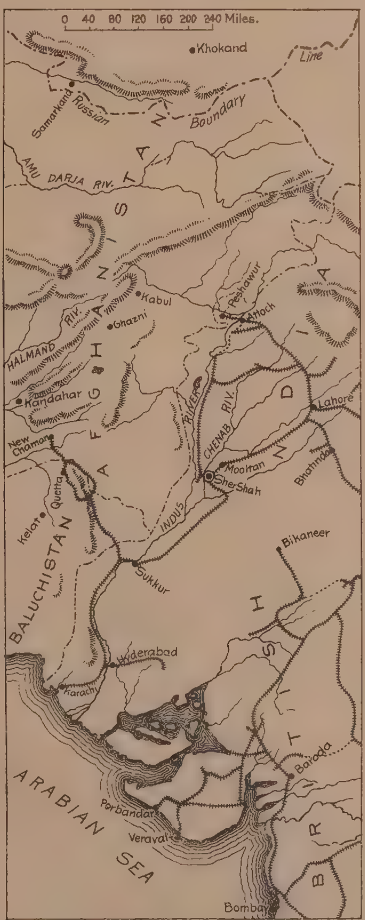
CONDITION OF RIVER DURING THE DRY SEASON OF 1887-88, PREVIOUS TO CONSTRUCTION OF TRAINING WORKS.



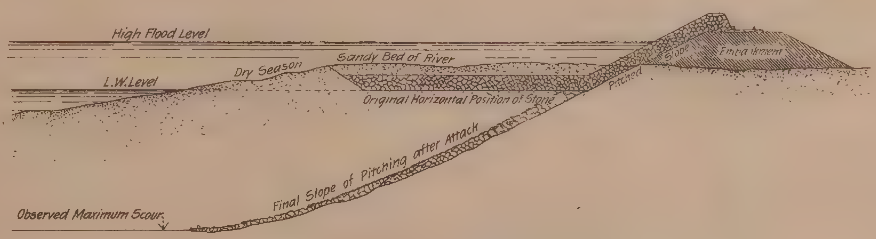
CONDITION OF RIVER DURING THE DRY SEASON OF 1890-91, SHOWING EFFECT OF TRAINING WORKS.



WHEEL LOAD DIAGRAM FOR 206-FT. TRUSSES.



SKETCH MAP SHOWING
FRONTIER RAILWAYS OF NORTHWEST INDIA.



TYPICAL SECTION OF TRAINING WORKS.

SHER-SHAH FORTIFIED BRIDGE AND RIVER TRAINING WALLS; CHENAB RIVER.-NORTHWESTERN RAILWAY, INDIA.

Engineers:

Sir A. M. Rendel, M. Inst. C. E.; J. R. Bell, M. Inst. C. E.;
F. J. E. Spring, M. Inst. C. E.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

enforced brake for passenger service. It is a well known fact that when a brakeshoe is applied to a wheel turning at high speed the coefficient of friction is very small at first, but rapidly runs up as the speed is reduced, so that the effective braking is done during the last part of the stop. Of course the possible brakeshoe pressure is limited by the friction during the last part of the stop and cannot be made greater than what would be sufficient to slide the wheels then.

The re-enforced brake apparatus just perfected by the Westinghouse company operates to reduce the brakeshoe pressure automatically as the speed decreases after the application of the brake, just about in proportion as the coefficient of friction increases, so that the net result is a constant retarding force on the train from the moment the brakes are applied.

The apparatus consists merely of a simple exhaust valve attached to the cylinder, which allows the pressure to flow off gradually from the cylinder after the brakes are applied and until the pressure falls to, say, 25 lbs., or whatever pressure will give the desired maximum braking force at the stop. Of course the brake leverage is adjusted so that this 25 lbs. will give a pressure of, say, 70% of the weight of the car on the brakeshoes, and hence when the brakes are first applied with their full force and a pressure of some 55 lbs. is attained in the cylinder, over double the ordinary braking force is exerted on the car. We expect shortly to give an account of some tests of this device in actual service on high-speed passenger trains.

The New York Brake Co. shows also a re-enforced brake for passenger service, designed on quite a different plan from the above. The addition to the ordinary brake apparatus consists in this case of an extra cylinder, the connections of which are arranged to grip automatically the piston rod of the main cylinder and exert an additional pull upon it when an emergency application of the brake is made. This extra cylinder does not begin its work until the first cylinder has taken up the slack in the brake rigging, so this extra cylinder can be made very short and uses only a small amount of air. The air supply for this extra cylinder comes, not from the auxiliary reservoir, but from the trainpipe. The valve which admits air to the cylinder is so designed that it will not open until the trainpipe pressure falls below the reservoir pressure. Of course, in ordinary service stops this does not occur, and the extra cylinder does not come into play. But in making an emergency application or even the full service application, the engineer can reduce his trainpipe pressure until it falls below the reservoir pressure. Air will then flow from the trainpipe into the extra cylinder, increasing the brakeshoe pressure on the wheels to twice or three times that ordinarily used. Then, as the speed falls the engineer continues reducing the trainpipe pressure and with it the pressure in the extra cylinders as fast as the brakeshoe friction increases. The release of these extra cylinders is effected automatically at the same time that the main cylinders are released.

The only thing to be said in criticism of these re-enforced brakes is htat where they are used passenger axles will have to be designed for a much heavier strain than has hitherto been the case. At present the maximum strain on an axle is the resultant of the strain due to the weight on the bearing and the strain at right angles due to the brakeshoe pressure against the wheel, say, 70%, of the first strain. With the re-enforced brake it is proposed to increase the brakeshoe pressure at high speeds 200 to 300%, making it 1½ times as great as the load due to the weight of the car, or even more than double this load if the higher figure is taken. Apparently a good many axles and a good many axle boxes and trucks will need some careful looking over and strengthening if such a strain is to be put upon them.

Re-enforced Brakes for Freight Cars.

The need for varying the brakeshoe pressure with the speed does not exist on freight trains as on passenger trains, as stops are all made from lower speeds and the variations in speed are comparatively small. What is wanted on freight cars is some means of varying the braking pressure with the load. Take a 60,000-lb. car, for example, weighing 25,000 lbs. light. Its brakeshoe pressure, if properly adjusted, will be set to 70% of 25,000 lbs. = 17,500 lbs. The total weight of the car when loaded will be 85,000 lbs.; so the brake pressure when loaded will be barely 20% of the weight on the wheels.

The re-enforced freight brake which is exhibited by the New York Brake Co. is designed on the same general plan as its re-enforced passenger brake, described above. There is the same extra cylinder and automatic grip mechanism, and the only difference is in the admission of air to the extra cylinder. This is taken from the main cylinder through a loaded check valve, which prevents its entry until the pressure on the main piston has taken up the slack in the brake rigging, whatever that may be. When the car is empty a cock in the pipe is closed, cutting off the extra cylinder from action. This cock is opened when the car is loaded and the apparatus works thereafter automatically with no attention from the engineer and with no changes from the usual method of handling the engineer's brake valve. A drawback to this device, of course, is that the opening or closing of the cock may be neglected, resulting in the latter case in an excessive pressure.

A re-enforced freight brake working on quite a different plan, and merely automatic, is exhibited by the Brake Pressure Regulator Co., and is the invention of Mr. Benj. Wolhaupter. In this device there is no additional cylinder. The brake is the ordinary standard freight car brake, and the adjustment of the leverage is such that the maximum pressure of the brakeshoes is about 70% of the weight of the loaded car instead of the empty car. To prevent the brakeshoe pressure from exceeding the desired limit of 70% of the total weight of the car and load, whether the latter be great or small, a movable fulcrum is introduced in the brake lever system connected by a lever to the car center pin. If the car is empty a pressure equal to 70% of the light weight will be exerted on the brakeshoes and then the car body will begin to lift, and the remainder of the piston travel will be expended in lifting the car body about ⅛ in., while the pressure on the shoes is maintained, but not increased. Of course, if the car is half or a third loaded, it will require greater force to move the fulcrum and lift the car body, and greater pressure will be exerted on the brakeshoes. Thus the weight of the car itself determines the limit of the brakeshoe pressure. With this device it need no longer be necessary to adjust brakes to 70% of the braked weight; 55% or 60% could be used, and thus all danger of slid wheels could be obviated and with more effective braking power than is now obtained.

It may occur to the reader that with the brake leverage adjusted to give nearly three times the maximum braking pressure that is now in use, the brakeshoe slack would require taking up three times as often. With an automatic slack adjuster this would not matter; but Mr. Wolhaupter gets around this difficulty in a different way. In the brake rigging he introduces a swinging lever which varies the leverage with the travel of the piston and causes the first couple of inches of travel of the piston to take the slack out of the rigging. As the piston moves the leverage changes and at the latter part of the stroke it exerts a straight pull on the cylinder lever as in the ordinary brake rigging.

Air Saver for Air-Brake Pumps.

It is difficult to understand this ingenious device without drawings, which we shall give in a later issue, yet it is still quite simple, and seems to us likely to be entirely effective.

The Crane company has hit upon a simple scheme for economizing air and aiding the release in working air-brake pumps. Instead of throwing away the exhaust from the engineers' valve in making service stops it is piped to a small reservoir provided with a valve which blows off at 15 lbs. pressure. The pump suction is connected to this reservoir, which is also provided with a check valve opening inwardly, so that air will flow into it freely when it is not under pressure.

The effect is that after a service stop has been made, the pump has a store of air under 15 lbs. pressure to draw from. Thus, just at the time when its supply of air is most needed for a quick release the capacity and speed of the pump are greatly increased. As the brakes are practically never operated with less than 20 to 25 lbs. pressure in the trainpipe, and the air-saving reservoir blows off at 15 lbs., the graduation features of the brake are not interfered with.

It may be questioned whether in case this valve should be stuck down, an accident might not be caused from the failure of the brakes to operate. Opinions on this point might differ, and an examination of the details of the valve would be necessary before an accurate opinion could be formed. In general, however, it would appear that the margin between the ordinary pressure in the trainpipe and the pressure at which the valve is set should be sufficient to blow it open even if stuck pretty tight. Again the reservoir will almost invariably be empty when a stop is to be made. Then in case an emergency stop should be called for, the proportion of air taken from the trainpipe at the engineer's valve is so small that there would probably be no trouble even if the reservoir were closed absolutely tight. And finally, by using duplicate valves the possible danger from both of them sticking at once reaches the vanishing point.

Besides the more rapid release and recharging of the brakes, the air-saving reservoir acts as a catch basin where dust and cinders may settle instead of passing into the pump. It also acts like the air chamber on the suction main of a pump to give a fuller supply to the cylinder with less throttling by the strainer.

Braking All Wheels of a Train.

One of the most important of recent improvements in American brake practice is the application of brakeshoes to those wheels of a train which were formerly left unbraked, viz., the center wheels of the six-wheel trucks used under sleeping, parlor and dining cars, and the engine truck wheels. Both the Pullman and the Wagner companies have brakeshoes on all the wheels of their exhibition trains, and this is also true of the exhibition train of the New York Central, all the cars of which have six-wheel trucks. The absence of shoes on the middle wheels is noted on the six-wheel trucks under the Krehbiel exhibition train, the Club car shown by the Central R. R. of New Jersey, and the sleeping, dining and baggage cars in the Canadian Pacific train.

The application of brakes to engine truck wheels is a much more recent improvement. The Old Colony R. R. was first to adopt this, and it is shown on the locomotive exhibited by that company, and also on the New York Central's famous 999 engine, on the locomotive exhibited by the Erie enginemen, and on one of the fast express engines in the Baldwin Locomotive Works exhibit.

Air-Brakes for Electric and Cable-Cars.

That some form of quick-acting power brake ought to be universally adopted on the electric and cable-cars which have so generally displaced horse cars on American street railways, admits of no doubt. The only form of street car power brake shown at the Exposition, however, is the Genett air-brake.

This is a straight air-brake deriving its pressure from a pump driven by an eccentric on the car axle. Of course, there is not the same need for an automatic brake in street-car service as in railway service. The car on which the pump is placed also carries two reservoirs. The pump delivers air into both of these until the desired standard pressure is reached. Then a governor lifts and holds open both suction valves of the pump and thereafter of course the pump piston moves freely doing no work and without moving the valves. The purpose of the two reservoirs is as follows: When the brakes are applied, air is used only out of the main reservoir, and full pressure is maintained in the auxiliary reservoir, so that the pump is not started. To release the brakes the air from the brake cylinders is allowed to escape to the atmosphere, but the valve between the two reservoirs which was closed when the brakes were applied is not opened until the car is again under full headway and power to operate the pump can be spared. Then the motorman turns the brake valve to a position in which the two reservoirs are connected and the pump restores the pressure. The capacity of the reservoirs is such that a dozen or more applications of the brake can be made without starting the pump and without serious loss of efficiency. The pump requires about ¾ HP. to operate it at ordinary car speeds and will furnish air enough to make a stop in 40 ft. travel of the car. Any desired number of trail cars can, of course, be operated. Apparently the only serious lack in the appartaus is the absence of any means for graduating the braking force except the throttling of the air by the motorman, which would require considerable skill.

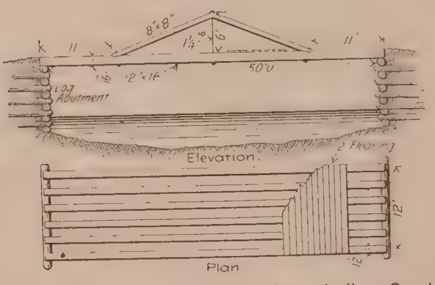
A FORTHCOMING HIGHWAY BRIDGE.

An old correspondent, who naturally does not care to appear in the matter by name, sends us the accompanying detail drawing of a new highway bridge now in process of construction in Tazewell Co., Va., which he accompanies by the following pithy letter, giving all the explanation that our readers will need of the structure and its reasons for existing:

Sir: As an addition to the highway bridge literature of the country, I beg to send you herewith a sketch of a county bridge soon to be erected over Indian Creek, about 5 miles above Cedar Bluff, Tazewell Co., Va.

The original plan contemplated merely six stringers, resting upon log or crib abutments. For this work the contract price was $115.

After the contract was let it was considered advisable to make "the bridge self-supporting," and the two inclined struts or rafters were added as shown.



Highway Bridge To Be Built Over Indian Creek, Tazewell Co., Va. County Road Commissioners, Engineers.

For this the contractor was allowed $30 additional, making the contract price for the bridge entire $145, which also includes the log abutments.

The bridge is, of course, a huge joke—to nonresidents of Tazewell Co., Va.—and will be enjoyed as such; but it makes one sick to think that there are hardly more than a dozen counties in the whole United States (or at least not more than 1% of them) which have taken any measures to put their highways and highway bridges in the hands of men who are entitled to any presumption that they know more about their duties than the commissioners of Tazewell Co., Va. Why cannot the state of Virginia, and all other states, employ at least one man who knows something about roadmaking and engineering, to travel as a missionary from county to county and prevent such work as this, even if the state is not yet ready to adopt a rational and permanent system of managing its highway work to the best advantage?

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 41.)

Canton, O.

A description of the screening chamber, inlet channel, precipitating tanks, sludge channel, pipe and well and effluent pipe connected with the chemical precipitation plant, at Canton, O., was given in our issue of June 1. The chemical mixers and sludge-compressing machinery and other accessories of the works are described below. The steps leading to the establishment of a sewerage system and purification works are interesting, as follows:

As long ago as 1880, when the population was 12,285, a report on a sewerage system for Canton was made by Col. Geo. E. Waring, Jr., M. Inst. C. E., who recommended the separate system, with 10½ miles of sewers, including an outlet to a creek. No action was taken on this report. On June 5, 1882, the Mayor, Wm. J. Piero, appointed five commissioners, who organized as follows: Wm. Dannemiller, President; Josiah Hartzell, Clerk; Wm. A. Lynch, E. O. Portman and Daniel Parr. The members of this board were appointed for five, four, three, two and one years, respectively, in the order named.

With the exception of one member the personnel of the board has remained the same until the present time, Mr. Wm. A. Lynch having been succeeded by Mr. W. R. Day.

The commissioners at once adopted the separate system of sewerage and in May, 1883, on the recommendation of Colonel Waring, employed Mr. J. J. H. Humphreys to prepare plans, which he did, and also, at the request of the commissioners, made a "preliminary report on the disposal of the city's sewage by absorption."

In April, 1884, a popular election gave a vote of 2 to 1 against the construction of sanitary sewers, which was partly explained by a general lack of understanding of the scheme.

The only available outlet for the sewage was into Nimishillen Creek, which, it appears, was an unpolluted stream with an approximate average flow of 7,000 gallons per minute, or 10,080,000 gallons per day. It was considered unwise to risk the pollution of this stream by sewage, and accordingly, in January, 1887, the commissioners employed Mr. S. M. Gray, M. Am. Soc. C. E., to report on the disposal of the sewage, which he did in March, 1887. Mr. Gray reported that during the greater portion of the year sewage could be discharged directly into Nimishillen Creek and for the remainder of the time recommended chemical precipitation, for which he submitted plans, land for the filtration of the effluent to be bought at the start so as to be available for future use, if it should be needed.

Mr. Gray made estimates for purifying the sewage by broad irrigation and also by intermittent filtration, but with either of these methods he found that pumping would be necessary, while for broad irrigation he did not consider that sufficient land for future needs was available.

Mr. Gray's estimates of the cost of purifying the sewage by broad irrigation, intermittent filtration and chemical precipitation are given below, the figures being based on using land in the same locality for irrigation or intermittent filtration, but a different tract, requiring no extension of the outfall sewer, for chemical precipitation. Estimates for other tracts were given, but the land included in the estimates below was considered the most suitable. The detailed estimates were as follows:

Broad Irrigation.

Extending sewer	$9,660
Engine and pump, house and land for same, force main, etc.	6,100
300 acres of land at $300 per acre	90,000
Preparing 120 acres	30,000
Total	$135,760
Contingencies	20,354
Sum total	$155,123
Interest on cost	$6,245
Cost of pumping per annum	1,942
Total expenses per annum	$8,187

Intermittent Filtration.

Extending sewer	$9,660
Engine and pump, house and land for same, force main, etc.	6,100
50 acres of land at $300 per acre	15,000
Preparing 12 acres of land, sludge tanks, etc.	10,450
Total	$41,210
Contingencies	6,182
Sum total	$47,392
Interest on cost	$1,896
Cost of pumping per annum	1,942
Total expenses per annum	$3,838

Chemical Precipitation.

Filter presses, chemical mixers, etc.	$10,500
House, tanks, connections, etc.	6,200
20 acres of land at $350 per acre	7,000
Total	$23,700
Contingencies	3,555
Sum total	$27,255
Interest on cost	$1,090
Cost of treating sewage 4 months in the year.	2,000
Total expenses per year	$3,090

It will be noticed that the figures for chemical precipitation are on the basis of only four months' treatment per year, and that the estimates for the other two methods make no allowance for caring for the sewage. It was assumed that the income from crops would meet the cost of tending the sewage farm or filter beds.

All the figures were based on a population of 12,000 connected with the sewers at the start with an increase to 50,000. The cost of treating the sewage chemically was assumed at 50 cts. per inhabitant per year, or 12½ cts. for the four months included in the estimate.

In 1891, we have learned since the article appeared in our issue of June 1, Mr. Gray submitted a new estimate of the cost of a chemical precipitation plant, in accordance with general plans accompanying the same; the figures included $18,300 for tanks, $13,700 for machinery and $500 for sundries, making a total of $32,500, not including land, buildings, engineering and superintendence.

On July 28, 1887, the sewer commissioners adopted chemical precipitation, as recommended by Mr. Gray, and on Jan. 30, 1888, the city bought 27.58 acres of land for disposal works. From the appointment of the sewer commissioners in 1882 until Sept. 8, 1889, Mr. John H. Holl, was city engineer; from that date until Sept. 8, 1891, Mr. R. R. Marble filled the office, when he was succeeded by Mr. L. E. Chapin, Assoc. M. Am. Soc. C. E., the present incumbent. On Feb. 16, 1892, City Engineer Chapin, as member of a special committee, submitted a report to the city council in which an account was given of a visit to the chemical precipitation works, at Worcester, Mass., and East Orange, N. J., and it was estimated that a precipitation plant for Canton would cost $38,000 for construction and $5,000 per annum for each million gallons of sewage treated per day. The flow of sewage at the time of the report was given as about 800,000 gallons per day. The committee recommended that immediate steps be taken to carry out Mr. Gray's general plan for chemical precipitation with the modification that continuous circulation through several tanks be employed instead of direct circulation through each tank without the passage of sewage to the others.

The construction of the precipitating tanks and the buildings close by them was begun in 1892, the work being done by contract. On Jan. 23, 1893, bids were received for the machinery and accessories necessary to operate the plant. The principal contractors for the tanks, machinery and appurtenances were as follows:

Machinery and boiler, Bonnot Co., of Canton; guide frames and platforms, the Wrought Iron Bridge Co., Canton; valves and standards, Ludlow Valve Manufacturing Co., Troy, N. Y.; masonry work of tanks, McKinney & Nicholas, Canton.

The specifications called for machinery capable of purifying 2,000,000 gallons of "house sewage" per day.

The building which covers the machinery is a frame structure with slate roof. The mixing and pressroom is 30 × 40 ft., above which there is a chemical storeroom of the same size into which teams can be driven over a bridge from an adjacent bank. The floor of the storeroom and the roof of this part of the building are supported by trusses designed to carry 50 tons of chemicals, a 2,000-gallon water tank, a span of horses and a wagon.

The boiler-room is 28 × 35 ft., lined with brick, and is but one story high.

The boiler is a 4½ × 12-ft. return tubular, with forty 4-in. tubes, and is provided with a feed pump and injector. The smokestack is of iron, 28 ins. in diameter and 53 ft. high above the grates. An 18-HP. vertical automatic slide valve engine, built by C. Aultman & Co., Canton, is used. The main engine shaft has a flywheel pulley which can be used for driving a small dynamo for lighting the building and grounds.

The pump is a horizontal, direct-acting duplex plunger, with an 8-in. steam cylinder and 5-in. water plunger, both of 10-in. stroke. By means of separate suction and discharge pipes sludge may be pumped from the sludge well to the filter press or water from a water supply well to the overhead clear water tank used in mixing the chemicals. A gravity governor is provided to automatically start and stop the pump so as to keep the tank full of water. The pump was built by the Voisard Steam Pump Co., Canton, O.

The lime is slaked in the chemical storeroom and diluted with water, as desired, after which it passes down to two chemical agitators, on the floor below. These are of wood, 6 ft. high, elliptical, with axes of 5 and 9 ft. Each agitator has two sets of beater arms on a vertical shaft geared to a horizontal shaft driven by power from the engine. The agitators are kept in operation while the chemicals are being added to the sewage. Sulphate of alumina will also be mixed on the second floor, diluted, and thence pass to the agitators.

From the agitators the chemicals pass into two flat cast iron pans, over the serrated lower edges of which they flow in small streams directly into the inlet channel, just below. Wooden baffle plates in the channel mix the chemicals with the sewage as it flows to the tank.

It is stated that it is necessary to cut out the first tank, by means of the flash board gates, after it has been in use for about two days. The clarified liquid is given time for further settlement, then decanted through the floating skimmer or effluent pipe, after which the sludge is drawn from the bottom of the tanks to the sludge well, all as described in our issue of June 1. Before the sludge is drawn from the sludge well, strong limewater is added to it to facilitate pressing.

The filter press, as well as the chemical agitators, was furnished by the Bonnot Co., Canton. It consists of 60 circular cells, built for 150 lbs. pressure, filled directly from the sludge pump. A screw and traveling head is provided for closing the press or opening it to remove the cells so that the sludge cakes can be taken out. Filtering cloths are placed between each cell, the joints having an elastic packing to prevent injury to the cloths. The water from the presses falls into a trough and is conveyed back to the sewage inlet channel.

The Bonnot Co. also has the contract for the machinery for the chemical precipitation plant now being built at Chautauqua, N. Y. The company has built several hundred filter presses and appurtenant machinery for use in clay works, potteries, etc.

The cost of the purification works ready for operation was as follows:

Plans, drawings, photographs and printing....	$260
Grading for tanks, buildings and about grounds.	1,831
Masonry tanks, inlet chamber and sludge well..	13,846
Cement wash on masonry walls, approximate..	287
Foundations for machinery and supply well...	237
Building, complete, except boiler room floor with tanks..............................	3,236
Boiler room floor and deck of screen chamber..	80
Iron gates, valves, weir guides, platform frames and iron pipe..............................	885
Machinery and boiler set up complete..........	4,500
Sodding and fencing..............................	244
Ripraping slopes at driveway and drainage....	421
Plumbing, pipe fittings and miscellaneous......	158
Inspection and superintendence...............	489
Total cost of construction..................	$26,483
Cost of land..................................	4,000
Total cost of land and construction..........	$30,483

Hourly sewage gagings during a period of 24 hours were made in the spring of 1893 to determine the amount of sewage to be treated. The measurements were made by means of weirs fitted to the 20-in. pipe, one weir being located below the last lateral sewer, and the other 2,400 ft. nearer the disposal works. The results of the gagings, with summaries for each four hours, were as follows, the difference between the two readings being due to the infiltration of subsoil water:

Sewer Gagings in 20-in. Outfall Sewer at Canton, O.
(Separate system.)

Manhole at Jackson Street.			Manhole in Saxton Land.		
	Gallons in			Gallons in	
Time.	One hour.	Four hours.	Time.	One hour.	Four hours.
7:15 a.m.	25,423		7:30 a.m.	27,123	
8:00	27,705		8:15	28,851	
9:00	30,054		9:15	30,643	
10:00	30,054	113,236	10:15	31,210	117,860
11:00	25,423		11:15	27,123	
12:00	24,314		12:15	27,705	
1:00 p.m.	25 423		1:15 p.m.	26,553	
2:00	27,123	102,283	2:15	28,281	109,662
3:00	26,553		3:15	27,705	
4:00	26,553		4:15	27,705	
5:00	25,423		5:15	27,705	
6:00	24,544	103,073	6:15	27,123	110,238
7:00	23,670		7:15	24,314	
8:00	22,881		8:15	23,670	
9:00	22,130		9:15	23,670	
10:00	21,074	89,755	10:15	22,130	93,784
11:00	20,016		11:15	21,074	
12:00	15,055		12:15 a.m.	15,270	
1:00 a.m.	15,055		1:15	16,135	
2:00	13,233	63,359	2:15	14,190	66,669
3:00	8,985		3:15	11,469	
4:00	8.985		4:15	9,792	
5:00	13,233		5:15	14,190	
6:00	13,233	44,436	6:15	14,190	49,641
Total..	516,142	516,142	Total..	547,854	547,854

The 31,712 gallons of infiltrated or subsoil water was equal to about 6% of the total flow at the upper weir, or about 13 gallons per lineal foot of sewer. The distance from the lower weir to the disposal works is about 4,800 ft., a part of which is through very wet ground, so that Mr. Chapin estimates that the daily amount of sewage at present will probably be about 800,000 gallons.

Of the 516,142 gallons of sewage which passed the upper weir during the 24 hours of gaging, it is estimated that about 46,000 gallons, or some 9%, of the total flow at the upper weir, was from the 63 flush tanks in use, meter measurements having shown that each tank used about 772 gallons per day.

In the spring of 1893 there were in use about 18 miles of sanitary sewers and nearly 900 house connections had been made. The average number of house connections in use Mr. Chapin estimates as 800, which, after deducting the water used for flushing, would give an average of 583 gallons of sewage per connection. It must be remembered that the gagings given above were only for a single day.

From 12 to 6 a. m., as shown by the above gagings, or during 25% of the 24 hours, only 14.6% of the total sewage flow occurred, and this was comparatively clear, probably largely due to leaky fixtures and subsoil water. From this Mr. Chapin concludes that from midnight to 6 a. m. the machinery could be shut down, one of the tanks being used for storage during this part of the night.

The information given above, and also in our issue of June 1, is abstracted from the report of the sewer commissioners, Mr. Chapin having prepared that part of the report which describes the purification works and the Secretary, Mr. Josiah Hartzell, the balance.

Under date of June 12, Mr. Chapin sent us the following information, in addition to that given in the report:

Mr. S. R. Gray, M. Am. Soc. C. E., prepared a plan of the works from which we obtained our early ideas, and it was by his recommendation that the method of chemical precipitation was adopted. All plans and details for the tanks, connections and machinery were prepared in my office under my direction.

The first sludge cakes were made May 15, 1893. So far we have been mainly experimenting as to the best method of handling the sludge, and doing the most effective screening, and as a consequence have been running the machinery only daytimes. We have been experiencing some difficulty in working the sludge through the pressure pump, due to the faulty design of the pump valve, and are now having a new pump constructed with ball valves to take the place of the one first set up, but which has not been accepted.

As soon as the new pump is set up, which will be in ten days, the works will be run night and day, the necessary labor, from our experience so far, being an engineer and laborer 12 hours during the day, at which time all the pressing will be done, and a night engineer only to keep the agitators running for the purpose of mixing the chemicals during the night. The capacity of each tank is about 200,000 gallons. The lime is weighed out in fixed charges every two hours, and dumped into a slaking tank, to which sufficient water is added, and after it has become thoroughly slaked is drawn off by gravity into the chemical mixers located on the first floor and directly below.

We are using, with the idea of determining the comparative economy, three grades of lime, known as Kelly Island, Marble Head, and a local product called Cairo lime. The cost of the latter is about $3.25 per ton of 2,000 lbs. delivered at the works. The lime is brought in bulk and hauled directly into the second story of the building and shoveled into a large bin having a capacity of 30 tons.

Results from the lime, so far as appearences of the effluent are concerned, are quite satisfactory.

The amount of lime used and to be used will be about seven grains per gallon from present indications, and it has been my intention to use about four grains of sulphate of alumina.

After the supernatent water has been drawn from the surface by means of the jointed skimmer pipes, the sludge is then drawn from the bottom of the tanks into the sludge drain, and from thence into the sludge well by gravity, where it remains in store until needed to fill the filter press, from which it is pumped directly into the press. However, as a matter of precaution, we are now erecting a low service pump, as originally contemplated, but which so far we have omitted, to lift the sludge from the sludge well into a storage tank, and from this storage tank take suction to the main pressure pump, and thence into the filter press.

The sludge cakes are approximately 28 ins. in diameter, 1½ ins. thick, and weigh about 45 lbs. each. I have weighed a number of cakes, but these cakes were imperfectly pressed, due to the sacks being of too fine material. As the sludge is pumped into the press it is limed by inserting a strong solution of lime into the suction chamber of the pump. As to how much lime is added I am unable to say, the practice being to cut off the supply of limewater to the running sewage while the press is being operated, as the exuded water from the press running back into the inlet channel furnishes all the lime necessary.

The sludge at present is dumped outside of the building and removed by carts. However, I am having a track constructed, which will extend from the westerly door of the pressroom directly across the tanks numbered one and two, so that the sludge car can be pushed across these tanks, and the sludge cakes dumped beyond the tanks and out of the way of the building, where they can be afterward hauled away at leisure and used as manure.

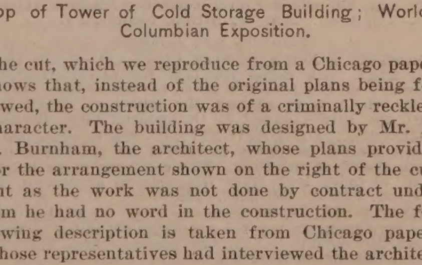
As to the amount of sludge per week, or per million gallons, I am unable to say definitely, but I think one press full of sludge per 200,000 gallons of sewage is what we may expect, resulting in approximately four presses of sludge, a total of perhaps 8,000 lbs. per day. These figures may be in excess of the actual amounts, when we come to treat all the sewage. An analysis of sewage both before and after treatment, and both with chemicals and without chemicals, is being made.

The screens are placed in the screen chamber two screens in each side, both consisting of flat bars of 3-16 × 1-in. iron, strung on rods forming the screen, the front one spaced 1¼ ins., and the rear one spaced ½ in. At the upper end of these screens and directly behind is a wrought iron tray, on which the rags and paper removed from the screens by means of a rake are caught and allowed to drain, and after draining are thrown into the boiler furnace and consumed. These screens are on an incline of about 45°.

The chemical agitators are driven by a vertical engine run at a rate of about 20 revolutions per minute. The monthly cost of operating the plant cannot be given with accuracy at present; the cost for labor will be approximately $150, the chemicals not far from the same, and coal and oil probably $50 more, making a total of $350 per month.

THE FIRE AT THE WORLD'S COLUMBIAN EXPOSITION.

In our editorial comment last week upon the burning of the Cold Storage Building, at the World's Columbian Exposition, we stated that according to report the tower extended above the top of the smokestack, and had been on fire before.



Top of Tower of Cold Storage Building; World's Columbian Exposition.

The cut, which we reproduce from a Chicago paper, shows that, instead of the original plans being followed, the construction was of a criminally reckless character. The building was designed by Mr. F. P. Burnham, the architect, whose plans provided for the arrangement shown on the right of the cut, but as the work was not done by contract under him he had no word in the construction. The following description is taken from Chicago papers whose representatives had interviewed the architect and obtained particulars from him:

> The architect's plans of the building show that the stack was built of iron and stood in the center of the high tower of the building on a brick pedestal 10 ft. in height. It was 7 ft. in diameter at the bottom

and 5 ft. at the top. It was lined with 9 ins. of fire brick to the height of about 75 ft., and above that there was no lining. The stack was quite strong. Being built of boiler iron it was self-supporting and stood in the center of a shaft 12 ft. square, which acted as a ventilator for the boiler room in the basement. The shaft terminated in the colonnade, which was just beneath the dome, where the fire started.

The stack passed through the colonnade and terminated just under the roof of the dome. Here the architect's plan calls for what is known as a "thimble," which is, practically, a section of the stack that was to connect with the main portion and extend on upward through the roof of the dome. The thimble was 6 ins. larger in diameter than the stack and was to slip over it. The space between the two was to be filled with asbestos, and the idea of the thimble was to take up the expansion of the iron in the high stack as well as to carry the smoke and sparks outside the roof. The "thimble" was never put in place, although it is said that the material for its construction was on the ground.

When the fire had burned away some of the nearest woodwork, as it had done twice before, the falling brands commenced to drop down alongside the stack and inside the 12-ft. shaft that inclosed it. The inside of the shaft was perfectly smooth, as it was lined with matched pine flooring. The burning wood found no lodging place until it fell to the bottom of the shaft and the base of the stack. Here the strong upward draft soon lifted the flames and fanned them to their greatest fury. The thin partition of the shaft was burned away and the building doomed before the unfortunate men above knew there was a fire below them.

TO DRAW RED LINES ON BLUEPRINTS.

A correspondent sends us the following method for producing bright red lines on blueprints. It is not new to many draftsmen, but as we know from experience that it works beautifully, we print it for the general benefit of our readers:

Make a saturated solution of carbonate of soda and add to it enough ordinary carmine writing ink, such as Stafford's or any other good quality, to make a mixture of desired color. Use this with pen, and let it dry without using a blotting paper.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

ALTOONA & PHILLIPSBURG.—Grading on this road in Pennsylvania has been completed as far as Ramey, and preparations are being made to lay the track at once.

BUFFALO, ROCHESTER & PITTSBURG.—It is reported that surveys will soon be made for an extension of this road to Pike, N. Y. The citizens of Pike are pushing the matter.

CENTRAL R. R. OF PENNSYLVANIA.—J. W. Gephart, of Bellefonte, Pa., writes us that a force of over 400 is now at work on this railway and that about ¼ of the grading has been completed. Work began May 15, and it is expected to begin tracklaying by Aug. 10 or 15 and have the line completed this year. The road is to run from Bellefonte to Mill Hall, Pa., 30 miles, through a farming country. The work is light and the grades and curves easy. There will be a number of small bridges. The principal business will be in ore, iron, limestone and the general merchandise traffic. The road is being constructed by the company; G. W. Gephart, Supt. of Cons.; H. E. Richter, Ch. Engr.

PENNSYLVANIA.—About $100,000 has already been subscribed toward an extension of this road from Angora to Newton Square, Pa., a distance of ten miles. The line will be known as the Philadelphia & Delaware County, and is to be commenced at once and completed within a year.

QUEBEC & LAKE ST. JOHN.—The Chicoutimi extension of this railway was opened for traffic July 10. The line runs east from a point 30 miles east of Chambord Junction to Chicoutimi, Que., on the Saguenay River, a distance of 21 miles.

SHADE CREEK.—This railway will be 8 miles long and is being built in the interest of the Cambria Lumber Co., John W. Morris, Supt., Seanor, Pa. All but 1½ miles of the track has been laid. The road will do a heavy business in lumber and bark, and eventually coal, but will not do a passenger business at present. Ch. Engr., Jas. W. Alfred, Seanor, Pa.

Projects and Surveys.

BOSTON & NOVA SCOTIA COAL CO.—C. M. Odell, Ch. Engr., has asked for bids for the grading and masonry of the first ten miles of the copmany's railway, which is to connect the mines at Broad Cove with the Inter-Colonial at Orangedale, Cape Breton.

KINGFIELD & DEAD RIVER.—The organization of this company has been completed by electing a complete board of directors. The company is to build a road 10 miles long from Kingfield to Jerusalem, Me. Weston Lewis, Gardiner, Me.

NEW YORK.—J. W. Spencer, Utica, N. Y., has made the permanent survey for a railway 3¾ miles in length from Morrisville, N. Y., to connect with the New York, Ontario & Western.

SOUTH MOUNTAIN.—It is reported that work will soon be commenced on a railway from West Reading, Pa., to Straustown, Pa. This is a branch of the old South Mountain R. R., surveyed and partly graded some years ago. The main line of the proposed road was from Harrisburg to Slatington, Pa.

Southern.—Existing Roads.

ATLANTIC, SUWANNEE RIVER & GULF.—Ch. Engr. Geo. Tompsett, of Starke, Fla., writes us that this road is projected to run from Jacksonville, Fla., via Bradford, Alacuha and Lafayette to Deadman's Bay, on the Gulf of Mexico, 100 miles, and that 63¾ miles have been surveyed and 5 miles of track laid. The route is through a rolling, sandy country, and the principal business of the road will be in logs and phosphate. The work is being done by the company. Pres., Thos. Denham, Starke.

CHESAPEAKE & CAROLINA.—This company is reported to be building a line of railway from Burgaw to Onslaw, N. C. Pres., E. L. Watkins.

NASHVILLE & KNOXVILLE.—An official is reported as saying that the partly graded extension from Algood to Standing Stone, Tenn, 11 miles, will be completed this year. Ch. Engr. R. J. Moscrip, Cookville, Tenn.

Projects and Surveys.

DRY FORK.—An officer of the company is reported as saying that most of the surveying has been done on the first 20 or 30 miles and through all the more difficult passes in the mountains. The right of way, so far as it was possible to get it by agreement, has been purchased; condemnation suits for the other parts of the route have been begun. Grading will be commenced within a few months, it is stated. The road is to be built for the purpose of developing the timber along the route, the forests being in their virgin state and showing splendid hardwoods. The route is from Bretz, W. Va., on the West Virginia Central & Pittsburg, along Dry Fork River, a branch of the Cheat River, through Tucker, Randolph, Pocahontas and Greenbrier counties to a point on the Chesapeake & Ohio Railroad. The principal stockholders are Levi Z. Condon, of Baltimore, Md.; Robert Whitmer, of Philadelphia, Pa., and Martin Lane.

MT. PLEASANT & ELKHORN.—This company has been organized with a capital stock of $3,300,000 to build a railway 160 miles long parallel to and along the west side of the Cumberland Mountains in Kentucky. Its southern terminus will be at Pineville, Ky. According to reports the section from Pineville to Harlan, Ky., about 25 miles, will be built at once. The names of the promoters are not given in the press reports.

Northwest—Existing Roads.

BAYFIELD HARBOR & GREAT WESTERN.—Pres. W. F. Dalrymple states that he expects to build 20 miles of this road from Bayfield, Wis., southwest at once. Ch. Engr., R. D. Pike, Bayfield, Wis.

NORTHWESTERN COAL.—Ch. Engr., C. J. A. Morris, 510 Endicott Block, St. Paul, Minn., writes us that this company is building 12 miles of railway at Superior, Wis. The road is being constructed to connect its docks with the various railways reaching the head of Lake Superior. It will be standard gage, with maximum curves of 3° and maximum grades of 1%, and through a generally level country except at the crossings of the water courses which are very deep. There will be several timber trestles from 30 ft. to 60 ft. high and 400 ft. to 800 ft. long. The contract for building 8 miles of the line has been let to McMullen & Morris, St. Paul, Minn., to be completed in the fall of 1894. The surveys have been completed and about ¾ of the right of way obtained. Incorporated April, 1893. Pres., E. N. Saunders, St. Paul, Minn.

WINONA, OSAGE & SOUTHWESTERN.—This company, which was incorporated some time ago to build the southern extension of the Winona & Southwestern R. R. in Iowa, has begun work, according to press reports. This is probably the mere ceremony of "breaking ground" to hold the subsidies voted by the municipalities along the route.

Projects and Surveys.

MINNEAPOLIS, ST. PAUL & LAKE SUPERIOR.—F. H. Anson, Minneapolis, Minn., writes that the surveys are in progress for this railway from Minneapolis and St. Paul, Minn., through White Bear, Custer City and Amidor, Minn.; Wolf Creek, Trade River, Yellow Lake and South Superior to West Superior, Wis., 135.8 miles. Work medium; principally sand, loam, clay, loose rock; maximum grade, 26.5%; maximum curve, 3°. The principal business will be in flour, wheat, coal, merchandise and lumber. About 100 miles of the right of way and land for the terminals have been secured, and contracts for construction let to Grant & Co., Fairbault, Minn. Tracklaying will possibly begin Dec. 1, but more probably about April 15, 1894. It is proposed to have the line completed by Aug. 1, 1894. Pres., Donald Grant, Faribault, Minn., Ch. Engr., T. D. Woodbury.

Southwest.—Existing Roads.

GULF, BEAUMONT & KANSAS CITY.—John H. Kirby, Houston, Tex., writes us that 20 miles of this road from Beaumont, Tex., north is nearly completed, the grading being practically finished and work now in progress, tracklaying and building bridges. The surveys are in progress for 90 miles through the towns of Jasper and San Augustine, Tex. The route is through a level, sandy and timber country, affording light grades and curves; and the principal business will be in lumber, stone, cotton and merchandise. Nearly all of the right of way is obtained and $40,000 secured from the city of Beaumont. The other capital has been secured from stock subscriptions in Boston, Mass. The contractors for the first section are: R. H. Downey & Bro., Beaumont; Pres., Edw. E. Pratt, 12 Pearl St., Boston, Mass; Ch. Engr., Louis J. Kopke, Beaumont, Tex.

KANSAS CITY, PITTSBURG & GULF.—The grading has been completed on the section from Pittsburg, Kan., to Joplin, Mo., and the bridgework is being rapidly pushed. Tracklaying will begin at once. South of Joplin good progress is being made with the grading and work is also in progress from the end of the line north of Texarkana, Tex., north toward the line from Joplin, Mo., south.

SOUTHERN PACIFIC.—The contract for constructing the Midland Branch was let on July 8 to J. P. Hughes, of Fort Worth, Tex. This branch leaves the main line near Etherwood, La., 175 miles west of New Orleans, La., and extends north about 22 miles. It is to be completed by Nov. 15, 1893. The maximum grade is 20 ft. per mile and the maximum curve 3°. E. B. Cushing, Engineer. The contract has been let for a 12-mile extension of the Louisiana Western R. R. from Lake Charles, La.

Projects and Surveys.

LAFAYETTE & BREAUX BRIDGE.—A movement is on foot to build a railway from Lafayette to Breaux Bridge, La. It is stated that an organization has been effected and committees organized to secure right of way and donations. L. T. Moss, C. O. Mouton, C. Girard, Lafayette, La.

Rocky Mt. and Pacific.—Existing Roads.

NEVADA SOUTHERN.—This company, which was chartered last December to build a railway from Blake, Cal., formerly Goffs, northwest to Vanderbilt and Good Springs, Nev., about 100 miles, has completed the line to Vanderbilt, it is reported, and will soon let the contract for the further extension to Good Springs. The road is projected to open up the Vanderbilt and New York mining districts. Pres., Isaac Blake, Denver, Colo.; Secy., Geo. C. Manley, Denver, Colo.; Gen. Man., R. S. Seibert, Meedles, Cal.

SAN PETE VALLEY.—It is announced that the partly graded extension to Manti, Utah, will be completed at once, the track materials having been ordered. The length of the extension will be 17 miles.

STREET RAILWAYS.

GARDNER, MASS.—It is reported that a franchise is about to be granted for a street railway four miles in length.

MILLBURY, MASS.—The Blackstone St. Ry. Co. has accepted the franchise recently granted by the selectmen of this town. This is the last franchise the company needs to accept to enable it to build its proposed line from Millbury to Northbridge, the franchises granted in the towns of Northbridge, Sutton and Grafton having been accepted some time ago.

PROVINCETOWN, MASS.—The selectmen have granted a franchise to J. M. Fellows, Natick, for an electric street railway.

BRIDGEPORT, CONN.—The Bridgeport Ry. Co. has been incorporated to consolidate the existing street railway line in this city; Pres., T. L. Watson.

NEW HAVEN, CONN.—Petitions have been presented to the selectmen for two street railways, one including a belt line in Westville.

WATERBURY, CONN.—The council has voted to permit the Waterbury Traction Co. to use the trolley system of motive power.

UTICA, N. Y.—Preliminary surveys have been made for the Utica, Rome & Sylvan Beach Electric Ry., a proposed road 16 miles long.

CARBONDALE, PA.—The Crystal Lake St. Ry. Co. has been incorporated to construct a railway from this place to Dundaff; capital stock, $50,000.

CARLISLE, PA.—O. H. Ormsby, Altoona, and Dr. S. R. Ickis, Pittsburg, are interested in the proposed Cumberland Valley Electric Passenger Co., which desires a franchise for a street railway in this place, with extensions to Mount Holly, Newville, Plainfield, Middlesex, Mechanicsburg and other towns.

ETNA, PA.—The Allegheny & Kiskeminetas Electric Ry. Co. has been incorporated to build an electric railway from this place to Sharpsburg, Aspinwall, Monrose, Hammansdale, Springdale, Kennedy and Hite Station; capital stock, $100,000.

M'CONNELLSBURG, PA.—The citizens have appointed a committee to secure the right of way for an electric railway to Mercersburg.

YORK, PA.—Wm. H. Lanius is president of the three companies noted last week as incorporated to construct electric railways from eight to ten miles in length each from this city.

WILMINGTON, DEL.—The Wilmington City Ry. Co. will soon change its remaining lines to the trolley system, and will also make extensions.

WASHINGTON, D. C.—Mackall & Clark have made surveys for the proposed Potomac & Great Falls Electric Ry., 4½ miles long, between Aqueduct Bridge and Falls Church, Va.; also an extension of this road to connect Alexandria and Georgetown.

NEW ORLEANS, LA.—The New Orleans Traction Co. will soon ask for bids for another car and repair house, and for the Canal Street power station, which will be of iron and brick, 300 × 280 ft., and is estimated to cost $60,000 to $75,000.——The St. Charles St. R. R. Co. has voted to increase its capital stock from $600,000 to $1,000,000, to change the motive power from mules to a better system, not yet decided upon.

COLUMBUS, O.—The Columbus Central Ry. has been incorporated, and has purchased the franchise of the Columbus & Westville R. R. Co. The proposed electric railway will be constructed as soon as possible.

NOBLESVILLE, IND.—It is reported that the Chicaga & Central Indiana Ry. Co. has awarded the contract for a double track electric railway between Chicago and Indianapolis to James Yule, Indianapolis. Orders have been placed for 500 miles of steel rails and for a 500-HP. compound engine to be used in the car works to be built in this city.

MARTINSVILLE, IND.—The commissioners of Morgan county have ordered a special election in Washington township looking to an appropriation of $40,000 in aid of the proposed electric railway between this city and Indianapolis.

ST. JOSEPH, MICH.—The St. Joseph & Benton Harbor St. Ry Co. has voted to issue bonds for $200,000, a part of which is reported as for extensions.

TECUMSEH, MICH.—A franchise for an electric railway has been granted to S. D. Nesmith.

MILWAUKEE, WIS.—The Milwaukee Electric St. Ry. Co. has been incorporated; capital stock, $300,000; Pres., Chas. Pfister; Treas., Chas. Landsee.

BELLEVILLE, ILL.—The council has repealed all ordinances granting other companies the right to build electric railways in the city, and has approved an ordinance granting the Citizens St. Ry. Co. the right to change its motive power from horse to electric.——The St. Louis Engineering Co. is reported as desiring a franchise for an electric railway in this city with an extension to St. Louis.

CENTRALIA, ILL.—The Centralia & Central City St. Ry. Co. has voted to increase its capital stock to $30,000, and to issue bonds for $20,000, to be used in extending the new line and putting on new equipment.

FREEPORT, ILL.—Chas. D. Haines, Kinderhook, and E. M. Ashley, Lockport, N. Y., are interested in a proposed electric railway at this place.

CLAYTON, MO.—The Clayton & Forest Park Electric Ry. Co. has increased its capital stock from $60,000 to $100,000.

DALLAS, TEX.—The Queen City Electric Ry. Co. has accepted the franchise recently granted, and filed a deed of trust to secure the payment of $350,000 of 6% bonds for extensions and equipment.——It is reported that work on the electric road to Fort Worth will soon be commenced.

SNOHOMISH, WASH.—The council has granted a franchise to the Everett & Snohomish St. Ry. Co.

HIGHWAYS.

OHIO.—The commissioners of Hamilton county have voted in favor of the improvement and extension of West Eighth St., and the building of a viaduct over Bold Face Road, and the auditor will sell bonds for $90,000 for this purpose.——The council of Bridgeport is considering plans for a new highway; estimated cost, $5,500.

WASHINGTON.—The commissioners of Chebalis county have appropriated $15,000 for highways.

BRIDGES.

FRANKFORT, KY.—The old footbridge is to be removed and a suspension bridge to cost $75,000 built to replace it.

CLEVELAND, O.—Plans are being prepared for a bridge to replace the South Water St. bridge, recently destroyed.

MANISTEE, MICH.—A swing bridge is to be built across the Manistee River at Smith St. Superstructure iron or steel, substructure stone masonry.

OMAHA, NEB.—The Board of Public Works has approved plans for steel, iron and stone viaducts over Fifteenth St. and Sixteenth St. That on Sixteenth will be 1,525 ft. in length, and will cost in the neighborhood of $175,000. Its width will be 58 ft. inside the curb, independent of the 8-ft. walks on each side. In its construction will be used about 3,000,000 lbs. of metal. The length of the Fifteenth St. structure will be 1,080 ft. Its width will be the same as the Sixteenth St., and will cost about $135,000. In its construction will be required about 2,225,000 lbs. of metal.

WATER-WORKS.

AUBURN, ME.—The committee on finance has voted to order a quantity of 24-in. pipe and to employ an engineer to make plans for improvements.

HANOVER, N. H.—R. Fletcher, Engr., informs us that the contract for the proposed dam for the Hanover Water-Works Co. has been awarded to L. A. Taylor, Boston, at about $15,400, other bids being $16,198, $19,300 and $20,541.

HENNIKER, N. H.—It is reported that a supply will soon be secured for fire and domestic purposes.

NORTH POWNAL, VT.—Surveys for works have been made by the North Pownal Mfg. Co. and land has been purchased.

LOWELL, MASS.—The contract for a new pumping station has been awarded to Bennett & Conlon.

NORTHAMPTON, MASS.—The commissioners are planning for a new 24-in. main to secure more pressure; estimated cost, $60,000.

SALEM, MASS.—The council has voted to lay a 12-in. main in Canal St.; estimated cost, $15,000.

PROVIDENCE, R. I.—The council has directed the commissioner of public works to contract for a 15,000,000-gallon high-duty pumping engine, the cost not to exceed $30,000.——It is reported that the city will adopt a system of mechanical filtration, as a result of the experiments that have been in progress since February.

MERIDEN, CONN.—It is proposed to extend a 6-in. main to South Meriden, at a cost of about $5,000.

WATERBURY, CONN.—The council has voted in favor of a dam 80 ft. high and a 36-in. main from it to the city, a distance of 11 miles.

FAIRPORT, N. Y.—The commissioners have decided to engage W. F. Randall, Syracuse, as engineer of proposed works. A test well will be put down as soon as possible.

FRANKFORT, N. Y.—Thos. Honohan, Comr., informs us that the Stanwix Engineering Co., Rome, has prepared plans for works estimated to cost $45,000, and that an election was called for July 18 to vote on the issue of bonds. The supply will be from springs running to open stream, and the plans include an 8,000,000-gallon reservoir and 40 hydrants.

GENEVA, N. Y.—Extensions have been decided upon to cost $25,000 to $30,000.

McCONNELLSVILLE, N. Y.—The McConnellsville Water Co. has been incorporated to secure a supply; capital stock, $1,000; directors, Theodore Chrestian, Lansing Tuttle and others.

ROCHESTER, N. Y.—The city wishes authority to construct a dam in the Genesee River, 150 or 180 ft. high, at a cost of about $1,500,000, to secure an additional supply. The state engineer and surveyor was to visit the city this week and investigate the question.

ST. JOHNSVILLE, N. Y.—We are informed that bonds for $25,000 will be sold July 27 to construct works. The specifications call for 4,632 ft. of 10-in. pipe, 5,292 ft. of 8-in., 12,084 ft. of 6-in. and 3,872 ft. of 4-in. pipe. A 1,500,000-gallon reservoir will be constructed, and 50 hydrants will be used.

SARANAC LAKE, N. Y.—The citizens have voted to issue bonds for $28,000 for works.

SOUTHAMPTON, N. Y.—The local water company has voted to increase its capital stock from $50,000 to $75,000 and to issue bonds for $25,000.

SYRACUSE, N. Y.—About five miles of conduit to Skaneateles Lake have been constructed and tested. It is reported that the completion of this will necessitate the replacing of about eight miles of cement pipes in the city with iron pipe.

BOONTON, N. J.—It is reported that arrangements have been completed for a supply.

HIGHTSTOWN, N. J.—The Hightstown Water Co. has been incorporated; capital stock, $50,000.

IRVINGTON, N. J.—The Irvington Water Co., which recently accepted a contract with the village for a supply, has contracted with the Commonwealth Water Co., Summit, to lay mains to this village and to furnish a supply.

SOUTH AMBOY, N. J.—There is talk of issuing bonds for $30,000 to lay mains to connect with Perth Amboy's supply.

ASHLAND, PA.—The council is discussing the building of a new reservoir, the present supply not being sufficient.

BLUE RIDGE SUMMIT, PA.—The Monterey Neighborhood Improvement Assn. is discussing a supply.

BRADFORD, PA.—The contract for about six miles of extensions has been awarded to M. B. Birdseye, Fayetteville, N. Y.

DUNCANNON, PA.—The Duncannon Home Water Co. has been incorporated by B. F. Ripple, Orbisonia; Frank W. Stewart, Huntingdon, and others; capital stock, $1,000.

ETNA, PA.—An election will be held Aug. 22 to vote on an issue of bonds for $100,000, of which $85,000 would be used to purchase the plant of the Etna Water Co.

FORKSVILLE, PA.—The town council is reported as considering the question of works.

LOCK HAVEN, PA.—Arrangements are being made to secure both temporary and permanent supplies.

MAHANOY CITY, PA.—The Mahanoy City Water Co. has recommended that the contract for works be awarded to M. P. Quinn & Co., at $84,156.

ORBISONIA, PA.—The Orbisonia Water Co. has been incorporated; capital stock, $1,000.

PITTSBURG, PA.—It is reported that the Suburban Water Co. will soon ask for bids for works to supply Oakland and Verona. Pres., J. M. Given.

PITTSTON, PA.—It is proposed to extend the supply to Hughestown, Cork Lane, Browntown and other outlying districts.

PIEDMONT, W. VA.—At a meeting of the town council July 11, Alexander Potter, New York, was engaged to prepare plans for works. A gravity system can probably be procured. Works will be completed this season.

SISTERSVILLE, W. VA.—Wm. H. Cushman, Engr., informs us that contracts will soon be awarded for works to cost about $11,000, the supply being from the Ohio River. The work includes a 12 × 30-ft. well, 300,000-gallon Snow pump, 11,500 ft. of 8 to 4-in. pipe. Addyston pipe, Rensselaer valves and Bourbon hydrants will be used. Alexander Potter, New York, Consult. Engr.

TROY, ALA.—It is reported that works will be constructed at a cost of $35,000.

MORRISTOWN, TENN.—D. C. Morris, Cy. Recorder, informs us that works are proposed estimated to cost $40,000. The supply will be from springs and pumped to a stand-pipe. The contracts will not be awarded until after bonds have been sold.

SHELBYVILLE, TENN.—E. Blakemore writes us that the city desires a private company to put in works, and that it will contract for a supply for 35 years. One company has submitted a proposition, but the city proposes to wait 30 days for a better offer before closing a contract; population, 3,000.

CANTON, O.—The contract for a 7,000,000-gallon pumping engine has been awarded to the Holly Mfg. Co., Lockport, N. Y., at $36,000.

CINCINNATI, O.—The board of administration will receive bids until Aug. 7 for four vertical pumps of 4,500,000 gallons capacity.

LINWOOD, O.—The village is negotiating with the city of Cincinnati for a supply.

MASSILON, O.—The plant of the Massilon Water Co. is to be sold at auction Aug. 5. It is appraised at $115,000, and it is proposed that the city buy it.

NORTH VERNON, O.—The Boughen Engineering Co., Cincinnati, has completed the works, which have been tested and accepted. The mains will be extended to additional parts of the city.

SANDUSKY, O.—Plans have been prepared for a new crib, and the committee has decided in favor of an octagonal one, estimated to cost $29,155.

YOUNGSTOWN, O.—The water-works trustees have decided in favor of a supply from Mill Creek. Two standpipes would be required and a settling reservoir used instead of a filter system, as proposed. Bonds for $350,000 are asked for.

COLUMBIA CITY, IND.—An election will soon be held to vote on the question of works.

QUINNESEC, MICH.—The township board has contracted with the Michigan Pipe Co. to repair the system built in 1886 for fire protection, instead of constructing a new system.

SAGINAW, MICH.—The committee has reported the following estimates for the improvement of the west side system: 6,000,000 or 7,000,000-gallon pump, $31,000; three new boilers, etc., $6,000; foundations for engine, etc., $3,000; new inlet pipe across the river and crib, $8,000; sundries, $2,000; leaving $50,000 to be used for replacing wooden pipes with iron and for extensions.

ATTICA, ILL.—An improved system is being discussed.

CENTRALIA, ILL.—H. Van Cleve, Cy. Clk., informs us that a supply is proposed from dams and reservoir on creek, two miles distant; estimated cost, $45,000; The work will probably not be advertised until bonds have been sold.

DUQUOIN, ILL.—It is reported that the council is trying to secure a complete system of works.

OTTAWA, ILL.—Jason R. Richardson, Jr., Cy. Clk., informs us that a supply is proposed from artesian wells, the complete works to cost about $125,000. The plans include a stand-pipe, to be located about 2½ miles from pumping station, and about 22 miles of mains. The work will probably be advertised next month. Geo. C. Morgan, Consult. Engr., Chicago.

FARIBAULT, MINN.—The city has purchased the works of the Faribault Water-Works Co. for $101,259.

FORT NIOBRARA, NEB.—Bids are asked until Aug. 1 for an additional supply at Fort Niobrara. G. B. Dandy, Deputy Q. M.

GORDON, NEB.—The contract for works has been awarded to Steve Kennedy, Nebraska City.

DILLON, MONT.—The San Francisco Bridge Co. bid $48,000 and Parsons & Bowman, Butte, $50,000 for works, each agreeing to accept city bonds at par in payment. Ray & Jingle, Engrs., Butte.

COLUMBIA, MO.—A contract has been awarded to the Western Filter Co., St. Louis, for a filter to cost about $4,000. The new works are nearly completed.

NEVADA, MO.—Efforts are being made to secure a new supply.

BONHAM, TEX.—W. C. Dean has been appointed engineer of new works, which will be constructed at once.

QUANAH, TEX.—The council is considering the issue of bonds for $10,000 for works.

WHITNEY, TEX.—Works will be put in by C. M. Carver, 6,600 ft. of pipe having already been ordered.

EDDY, N. MEX.—The City Water-Works Co., has been incorporated; capital stock, $100,000.

PUEBLO, COLO.—The Pueblo Land, Power & Water Co., recently granted a franchise for an electric plant, proposes to furnish the city with a supply of filtered water and allow the city to distribute the same.

ATHENA, ORE.—Bids are asked until Sept. 1 for $12,000 of water bonds. I. J. Kirk, Chn. Com.

YARMOUTH, N. S.—It is reported that the town has bought the local works for $238,244 and will spend about $60,000 in improvements and extensions.

BRANTFORD, ONT.—The commissioners have decided to construct two reservoirs near the present works.

ARTESIAN WELLS.

UPPER MARLBOROUGH, MD.—Subscriptions are being raised to secure a supply from an artesian well.

MAQUOKETA, IA.—It is reported that an artesian well is to be sunk.

CALEDONIA, MINN.—The village has purchased land for the purpose of sinking an artesian well, with a view of a water-works site and electric light plant.

BLAIR, NEB.—The city will soon sink two 6-in. wells, it is reported.

YANKTON, S. DAK.—Bids are asked until July 31 for sinking a 6-in. artesian well 1,000 ft. deep at the Hospital for Insane. Z. Richey, Secy.

IRRIGATION.

EL PASO, TEX.—A. F. Spawn and others, of London, Eng., have been in the city to make an estimate of the cost of constructing the proposed international dam across the Rio Grande, above this city. It is thought the work would cost about $4,000,000, including a 40-ft. canal 35 miles long to irrigate over 1,000,000 acres in the Rio Grande Valley.

NEW COMPANIES.—Johnson County Canal & Reservoir Co., Cheyenne, Wyo.; $100,000; A. K. Kissock, E. H. Hall, John McPherson, F. J. Annis.——Idaho & Oregon Irrigating Co., Payette, Idaho; $100,000; H. B. Moss, F. C. Moss, J. H. Richards.——Agua Fria Construction Co., Covington, Ky.; $200,000; H. L. Morey, Collins Ford, W. H. Beardsley.

SEWERS.

FAIRHAVEN, MASS.—The committee is considering plans for a system.

HOLYOKE, MASS.—Bids will soon be asked for work, including 100 ft. of 3-ft. iron pipe.

AMSTERDAM, N. Y.—Bids will be received until Aug. 3 for 1,000 ft. of 20-in., 1,730 ft. of 15-in. and 1,100 ft. of 10 and 8-in. storm sewer. Howard Putnam, Secy. Comrs.

CORNING, N. Y.—The city engineer has reported that a proposed sewer would cost about $25,000.

FLATBUSH, N. Y.—A contract has been awarded to John Bray, at $36,640, other bids being, Harris Bogart, $36,746; James Deighan, $37,608; John Lick, $38,715; E. J. Cream, $39,640; Cranford & Co., $49,090; Robert Furey, $52,630.

GLOVERSVILLE, N. Y.—The contract for 6,850 ft. of 12 to 6-in. and 2,500 ft. of 4-in. pipe sewers has been awarded to S. C. Ferguson at $6,732. E. B. Baker, Engr.

WATERTOWN, N. Y.—The board of public works has petitioned for authority to construct sewers estimated to cost about $80,000.

PHILADELPHIA, PA.—The director of public works will receive bids until July 26 for main and branch sewers.

COLUMBIA, S. C.—The council has adopted the report of the sewer committee for a system. R. F. Hartford, Consult. Engr., Atlanta, Ga.

ASHLAND, KY.—The council has voted to advertise for bids for a sewer in Seventeenth St., from Lexington St. to the river.

COLUMBUS, O.—The council has voted to issue $100,000 of bonds for main trunk sewers.

DAYTON, O.—The following bids were received for sewers in district No. 8: Jos. Munger & Co., Dayton, $82,420; Bruno Ritty, Dayton, $102,098; B. D. Barton, Port Huron, Mich.; $74,760; W. A. Cain and J. E. Lowes, $97,868; Ed. Ryan, Springfield, $115,793; Oliver Kringle, Dubuque, Ia., $95,028; Clements Bros., Cleveland, $100,347; Standard Const. Co., Columbus, $87,755.

AUSTIN, ILL.—Bids will be received until July 28 for a pipe sewer. Ed. S. Austin, Clk. town of Cicero.

STREATOR, ILL.—We are informed by W. B. Burson, Cy. Engr., that a contract for 7,564 ft. of 24 to 8-in. pipe sewers, average cut 9.2 ft., has been awarded to Jas. Scott, Streator, at $5,600.

DAVENPORT, IA.—The council has voted to issue $60,000 of sewer bonds.

DES MOINES, IA.—The board of public works will receive bids until Aug. 3 for four 18 to 12-in. pipe sewers.

DULUTH, MINN.—A. S. Cooper, Cy. Engr., has prepared plans for sewers to cost $35,000 to $40,000.

FARGO, N. D.—Bids will be received until July 31 for about five miles of 9 to 20-in. pipe sewers. J. Tudor Graves, Cy. Engr.

KANSAS CITY, MO.—The High Gate Drainage Co. has been incorporated by E. F. Swinney, Walker Cowherd, William Barton and others to construct sewers; capital stock, $2,000.

MARSHALL, MO.—It is reported that an effort will be made to issue bonds for a system.

SALT LAKE CITY, UTAH.—The committee on sewers is considering the purchase of a 3,000,000-gallon pump.

STREETS.

BROOKLYN, N. Y.—The contract for grading Seventh Ave., in New Utrecht, has been awarded to John Curran, at $90,000.

GREENBUSH, N. Y.—Bids are asked until July 24 for paving with granite blocks. Chas. J. Quinn, Chn. St. Com.

SYRACUSE, N. Y.—The following bids were received for paving East Genesee St. with asphalt, from Mulberry St. to the city line: Warren-Scharf Asphalt Paving Co., $167,215; Syracuse Improvement Co., $170,003; Trinidad Asphalt Refining Co., $175,656.

TONAWANDA, N. Y.—It is reported that bids will soon be asked for paving North and South Canal Sts.

JERSEY CITY, N. J.—Bids are asked until July 31 for 3,300 sq. yds. stone paving, 2,000 lin. ft. stone curbing, etc. Geo. I. Bouton, Clk. St. Comrs.

PITTSBURG, PA.—The board of public works will receive bids until July 28 for grading, paving and curbing in eight streets.

READING, PA.—The council has voted to pave two streets with vitrified brick.

KNOXVILLE, TENN.—The contract for paving several streets has been awarded to Andy Gillespie, Man. Virginia Cons. Co., Lynchburg, Va. This company makes the Chilhowie brick, and its bid is reported as about $20,000 less than any other.

COVINGTON, KY.—The council has voted to pave five streets with brick.

BUCYRUS, O.—The following bids have been received for vitrified brick paving: Frazer & Kiel, $28,571; A. H. Gardner, $29,435; Herring, Straub & Gaudert Bros., Mansfield, $32,053; engineer's estimate, $29,807.

CINCINNATI, O.—The board of administration will receive bids until July 29 and Aug. 8 for paving with asphalt, and until Aug. 11 for paving with brick and macadam.

MARIETTA, O.—Bids will be received until Aug. 12 for paving with brick. L. Mueller, Cy. Clk.

ZANESVILLE, O.—The council has rejected the bids for street paving. The lowest was $1.15 per sq. yd.

TERRE HAUTE, IND.—Bids will be received until Aug. 15 for paving with asphalt. Chas. H. Goodwin, Cy. Clk.

DETROIT, MICH.—The Talbot Paving Co. made the lowest bid for paving several streets with brick, at $44.341, also the only bid for paving one street with cedar blocks, at $23,164.

KALAMAZOO, MICH.—The Rose Street Improvement Co. has been incorporated; capital stock, $25,000.

MARQUETTE, MICH.—The cost of the proposed paving of Front St. is estimated as follows: Common cedar blocks, $1.05 per sq. yd.; sapless cedar blocks, $1.65; vitrified brick, $3.

DANVILLE, ILL.—Bids will be received until Aug. 15 for curbing two streets with stone. E. G. Dickerson, Cy. Engr.

ROCK ISLAND, ILL.—Bids are asked until Aug. 7 for paving two streets with brick. A. D. Huesing, Cy. Clk.

STREATOR, ILL.—Bids will be received until Aug. 7 for 86,495 sq. yds. brick paving, 44,740 lin. ft. stone curbing and 26,958 cu. yds. grading; estimated cost, $175,314. W. B. Burson, Cy. Engr.

DES MOINES, IA.—The board of public works will receive bids until Aug. 3 for paving one street with brick and grading six alleys.

KEOKUK, IA.—A contract for paving has been awarded to George Kreichbaum & Co., Burlington, at $19,706 for Keokuk brick, or $20,350 for Galesburg brick.

ST. CHARLES, MO.—The council has voted to repave Main St. with vitrified brick.

DENVER, COLO.—The city engineer estimates that the proposed paving of Larimer St. will cost $151,482.

MONTREAL, QUE.—Contracts for paving with block stones have been awarded to F. D. Lawrence, at $14,290; Sicilian Asphalt Paving Co., at $25,744; Mr. McKenna, at $27,950. Contracts for paving with asphalt were awarded to Bastien & Valiquette, at about $40,000, and to the Sicilian Asphalt Paving Co., at about $175,000.

ELECTRIC LIGHT AND POWER.

PAWTUCKET, R. I.—Chas. H. Herrick, of the Wright Electrical Engineering Co., Boston, has prepared plans for a municipal electric light plant, estimated to cost $84,260, and the special committee has recommended that the city build the plant.

BINGHAMTON, N. Y.—The council has directed the clerk to advertise for bids for 250 arc lights and 70 gas lamps for one, two or three years, bids to be opened July 31.

ETNA, PA.—An election will be held next month to vote on the issue of bonds for a municipal lighting plant.

HAVRE DE GRACE, MD.—Hughes & Rigby, Baltimore, have been awarded a contract for a plant for 1,000 incandescent lamps.

TOLEDO, O.—The council is considering a proposition of the water-works commissioners to establish an electric light plant in connection with the water-works. It is claimed that the city would thus save $30,000 a year.

AURORA, NEB.—The citizens have voted to construct a municipal electric light plant.

INDEPENDENCE, MO.—The committee on lights has been instructed to ask for bids for lighting the city for six months.

LITTLE ROCK, ARK.—Geo. McLean is interested in a proposed plant.

MEXIA, TEX.—Aldermen J. W. Blake and J. E. Ross have been appointed a committee to contract for an electric light plant.

PUEBLO, COLO.—The Pueblo Land, Power & Water Co. has been granted a franchise for furnishing electric power in this city. A plant will be constructed at Rock Canon, six miles above the city, which will furnish 800 HP.

NEW COMPANIES.—Hightstown Electric Light & Power Co., Hightstown, N. J.; $50,000; J. Shields, Flemington; N. W. Birdsell, R. H. McCarter, Newark.——Sterling Light Co., Trenton, N. J.; $2.000,000; H. H. Brown, Trenton; Jos. Carson, C. E. Strong, New York.——Gibbs Electric Co., Milwaukee, Wis.; $2,000; Geo. Gibbs, L. T. Gibbs, J. W. Satterlee.——Excelsior Electric Co., Tarrytown, N. Y.; $50,000.——Michigan Electric Heating Co., Detroit, Mich.; $50,000.

CONTRACT PRICES.

WELLS.—Orrville, O.—The contract for drilling four 8-in. wells has been awarded to Hollenbeck & Moore, West Farmington, at 75 cts. per lin. ft. The wells will probably be 225 ft. deep, through sandstone. Alexander Potter, Engr., New York.

PIPE.—Rochester, N. Y.—Bids were opened July 11 for 60-in. pipe for the intake at the lake for the new conduit, the lowest being as follows: Carroll-Porter Boiler & Tank Co., Pittsburg, Pa., 680 ft. of riveted steel pipe of plate ⅜-in. thick and provided with angle iron stiffening rings every 14 ft., $11.60 per lin. ft.; 100 ft. of pipe same kind except the stiffening rings, $10.80 per lin. ft.; 800 ft. of plate 5-16-in. thick, $9.40 per lin. ft. The Central Bridge Works, Peterboro, Ont., was the lowest bidder for furnishing 15 ball and socket joints, at $290 per joint exclusive of customs duty.

ASPHALT PAVING.—Utica, N. Y.—Bids have been opened for paving several streets with asphalt, the prices and bidders for the work on Rutgers St. being as follows: 1, Trinidad Asphalt Refining Co.; 2, Utica Paving Co.; 3, Warren-Scharf Asphalt Paving Co.

	1.	2.	3.
Tile drains, per lin. ft.	$0.47	$0.29	$0.42
Resetting curb, per lin. ft.	.15	.05	.05
New curb, per lin. ft.	.57	.50	.52
Catch basins, each	45.00	33.00	40.00
Branch pipe, straight, per lin. ft.	.55	.35	.50
" " curves, per lin. ft.	1.50	.70	1.00
Manholes, each	55.00	40.00	50.00
Paving, per sq. yd.	2.79	2.20	2.77
Repaving, stone, per sq. yd.	.35	.10	.35
Relaying crosswalks, per sq. ft.	.08	.05	.08
New sandstone crosswalks, per sq. ft.	.25	.18	.22
Concrete, per cu. yd.	5.00	5.00	5.00

BRICK PAVING.—Cedar Rapids, Ia.—The lowest bid for certain paving with brick was as follows: J. E. & C. P. Murray—two courses of brick upon sand, $1.75 per sq. yd.; one course of brick upon 6 ins. of macadam and sand, $1.60; one course upon two 5-in. layers of macadam and sand, $1.85; resetting old curbing, 15 cts. per lin. ft.; limestone curbing, 65 cts. per lin. ft.; cement curbing, 55 cts. per lin. ft.; extra excavation, 24 cts. per cu. yd.; 4-in. tile where needed, 9 cts. per lin. ft.

MACADAM PAVING.—Boston, Mass.—Bids have been opened for paving about 1,700 lin. ft. in Commonwealth Ave., the itemized prices being given in this order: Subgrading 2,500 cu. yds.; telford base, 7,400 sq. yds.; paving gutters, 1,325 sq. yds.; loaming planting space, 6,600 sq. yds.; setting edgestones, 1,700 lin. ft.; laying crosswalks, 65 sq. yds.; plank sidewalks, 1,700 lin. ft.; fence, 1,700 lin. ft. The bids were as follows: O'Connor & White,—42 cts., $1, 30 cts., 60 cts., 34 cts., $1, 56 cts., 56 cts. H. P. Nawn, 35 cts., 90 cts., 75 cts., 50 cts., 35 cts., $1, $1, 50 cts. F. H. Cowen, 30 cts., 79 cts., 85 cts., 55 cts., 45 cts., $1.15 $1.02, 48 cts. Robert A. Davis, 32 cts., 95 cts., 93 cts., 52 cts., 45 cts., $1.15, $1, 40 cts.

BRIDGE ABUTMENTS, ETC.—Indianapolis, Ind.—The following bids have been received by the board of public works: Construction of the abutments for the Vermont St. Bridge,—Richter & Barnhart, masonry, $9.28 per cu. yd.; coping, 64 cts. per cu. ft.; dry excavation, 25 cts. per cu. yd.; wet excavations, 50 cts. per cu. yd.; Moos & Tielking, $10.50, 90 cts., 20 cts., 80 cts., respectively; Hege, $8, 53 cts., and 30 cts. for excavations. Lowering the bed of Pogue's Run,—Browder & Shover, excavations, 80 cts. per cu. yd.; riprap, 80 cts. per cu. yd.; J. L. Fisher, 87 cts. and $1.50; A. Rubush, 90 cts. and $1.60; W. H. Abbott, 90 cts. and $1.20.

POWER HOUSE, RESERVOIR, ETC.—Linwood, O.—We are informed by Geo. Hornung, Engr., that the following contract has been awarded to A. Wilson, at the prices given: Power house, $8,300; boiler chimney, $1,122; boiler foundation, 34 cu. yds. limestone at $5; machinery foundation, 20 cu. yds. brick masonry, at $6.50, and 400 cu. ft. capstones, at 81½ cts.; 6-in. iron pipe sewer, 70 lin. ft., at 60 cts.; 4-in. iron pipe sewer, 70 lin. ft., at 40 cts.; total, $10,508. Morton & Johns bid $9,500, $1,070, $7.25, $7, $4, $1, $1, $13,116, respectively, and T. A. McClains & Son $8,700, $1,300, $5, $7 80 cts. 75 cts. 60 cts., $11,144.——The contract for reservoir and tank foundation work was awarded to Wm. C. Murray, as follows: Reservoir,—earth excavation, 2,060 cu. yds., at 40 cts.; rock excavation, 2,800 cu. yds., at 90 cts.; slope and bottom puddle, 940 cu. yds., at $1.25; pipe trench puddle, 111 cu. yds., at $1; slope paving, 1,110 sq. yds., at $1; concrete bottom, 72 cu. yds., at $5; concrete pipe collars, 3 cu. yds., at $6; sodding, 617 sq. yds., at 20 cts.; gravel walk, 317 sq. yds., at 23 cts.; tank foundation.—earth excavation, 60 cu. yds. at 90 cts; limestone masonry, 45 cu. yds, at $8; total, $6,728. P. Gleason & Son bid 60 cts., $1.25, $1.25, $6.25, $1.25, $5, $6.25, 16 cts., 25 cts., $1.25, $9, $9,029, respectively.

BRUSH, ROCK, ETC.—Rock Island, Ill.—Maj. A. Mackenzie, U. S. Engineer Office, opened bids July 6 for Mississippi River improvements, and recommended the following for acceptance: For furnishing brush on U. S. barges,—Gasaway Bros., Dallas City, Ill., 30,000 cu. yds. between Keithsburg, Ill., and Montrose, Ia., 30 cts. per cu. yd.; Samuel Monroe, Portsmouth, O., 20,000 cu. yds. between Quincy Bridge and Clarksville, Mo., 30 cts.; Hunter & Frey, Memphis, Tenn., 50,000 cu. yds. within 25 miles of Piasa Island, Ill., 24 cts.; Christian Massneger, Fountain City, Wis., 30,000 cu. yds. between St. Paul and Lake Pepin, Minn., 29½ cts., and 25,000 cu. yds. between Fountain City and Genoa, Wis., 24½ cts.; riprap rock on U. S. barges,—Amos K. Roberts, Nauvoo, Ill., 15,000 cu. yds. at Nauvoo, Ill., 63½ cts., and 10,000 cu. yds. at Burlington, Ia., 68 cts.; John Benson, Hastings, Minn., 10,000 cu. yds. between St. Paul and Lake Pepin, Minn., 54½ cts.; Albert Kirchner, Fountain City, Wis., 10,000 cu. yds. sandstone between Fountain City, Wis., and Brownsville, Minn., 53 cts.; construction of dams and shore protections,—Jas. Short, St. Charles, Mo., between Clarksville, Mo., and Hamburg, Ill., 25,000 cu. yds. each of rock and brush in place, $1.35 and 49 cts., respectively, and between Cap au Gris, Mo., and mouth of Illinois River, 30,000 cu. yds. of each, $1.24 and 44 cts.; V. A. Bigelow, La Crosse, Wis., and A. B. Teasdale, Cassville, Wis., between Genoa and Prairie du Chien, Wis., 25,000 cu. yds. of each, $1.14 and 40 cts., and between Dubuque and Clinton, Ia., 25,000 cu. yds. of each, $1.24 and 47 cts.; Jacob Richtman, Fountain City, Wis., between Smith's Bar and Lake Pepin, Minn., 30,000 cu. yds. of rock, $1.20, and 20,000 cu. yds. brush, 40 cts.; also between Hamburg, Ill., and Cap au Gris, Mo., 37,000 cu. yds. of each, $1.25 and 50 cts. Bids for 15,000 cu. yds. rock between Hannibal and Clarksville, Mo., ranged from 58 to 85 cts., and it was recommended that all be rejected.

MISCELLANEOUS.

FILLING.—Salem, Mass.—The council has appropriated $12,000 for filling Porter's Cove.

GARBAGE CREMATORY.—Terre Haute, Ind.—A committee from this city has been in other states investigating garbage cremators and has reported in favor of purchasing a 50-ton furnace to cost from $5,000 to $7,000.

IMPROVEMENT COMPANY.—Seattle, Wash.—The Washington Waterway & Tide Land Improvement Co. has been incorporated by Eugene Semple, Harry White and F. E. Sanders to dig a waterway south of this city and use the earth taken out in filling up the tide flats; capital stock, $500,000.

LEVEE WORK.—Washington, D. C.—The Secretary of War has approved a project submitted by Captain Mills for constructing a levee on the neck of the Mississippi River above Natchez, Miss., authorized by the river and harbor act of July, 1892. The object of the levee is to prevent a flow across the neck in high water, and the levee is to be constructed along the axis of Cowpen Point; estimated cost, $50,600; amount available, $78,500.

BONDS.—Lansing, Mich.—Bids are asked until July 24 for $60,000 of electric light bonds and $25,000 of bridge bonds. Wm. C. Hinman, Cy. Clk.

Hudson, N. Y.—The city will sell at public auction Aug. 1, $25,000 of street improvement bonds and $30,000 of public school bonds. Geo. G. Miller, Mayor.

Xenia, O.—Bids are asked until Aug. 10 for $50,000 of Green county road improvement bonds. W. R. Baker, Co. Aud.

PARK IMPROVEMENTS.—Providence, R. I.—The council has appropriated $25,000 for improving Davis Park, and the work will be advertised as soon as possible.

New York, N. Y.—The department of parks will receive bids until July 25 for grading, draining, etc., in Van Cortlandt Park, including 16,000 cu. yds. earth excavation, 150,000 cu. yds. filling, 727 lin. ft. 5½-ft. brick sewer, 5,000 lin. ft. 4 and 6-in. drain tile, 22,000 ft. B. M. lumber; construction of enclosure wall, walks, etc., for entrance to Central Park at 110th St. and Fifth Ave.; and for cattle sheds at the menagerie in Central Park.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Schenectady Locomotive Works, Schenectady, N. Y., are building two passenger locomotives for the Gulf, Beaumont & Kansas City.

The Brooklyn Bridge Trustees, Brooklyn, N. Y., will receive bids until Aug. 7 for a switching engine capable of service on 100-ft. curves. Chf. Engr. and Supt., C. C. Martin.

CARS.—The South Baltimore Car Co., South Baltimore, Md., is building 50 excursion cars for the World's Columbian Exposition traffic of the Baltimore & Ohio (Eng. News, June 8), and also 500 freight cars for different roads.

The United States Car Co., Anniston, Ala., is building 700 freight cars for the Louisville & Nashville.

The Buffalo Car Mfg. Co., Buffalo, N. Y., is building 250 freight cars for the Beech Creek.

The Columbian Car Co., Cincinnati, O., has been organized by Lee H. Brooks, T. C. Bradford and Benjamin W. Putnam, with a capital stock of $500,000.

The Terre Haute Car Co., Terre Haute, Ind., has made an assignment; liabilities, $191,165; assets, $599,082. There are contingent liabilities of $84,607.01, being indorsements for Post, Martin & Co., of New York. The stringent money market caused the assignment, and the company expects to be on its feet again in a few months.

THE PITTSBURG TESTING LABORATORY, which has been under the sole proprietorship of Hunt & Clapp, was reorganized July 1, 1893, and is now owned by a limited partnership, under the state laws of Pennsylvania, under the title of the "Pittsburg Testing Laboratory, Limited." The central office will still remain at 116 Water St., Pittsburg, and the management and staff of the new concern are not changed, except that some of the old employees have been admitted to the new limited company, in addition to the former proprietors, Messrs. Alfred E. Hunt and Geo. H. Clapp. The officers are as follows: Chairman, Geo. H. Clapp; Vice-Chm. and Tres., Alfred E. Hunt; Secy., J. M. Bailey; Gen. Man., A. B. Bellows; First Treas., L. S. McKeever.

THE WATEROUS ENGINE WORKS, Brantford, Ont., will be enlarged. The new machine shop will be 120 ft. × 400 ft. long, with a height of 2 stories, or 50 ft. A foundry of 125 × 100 ft. will also be built, and besides new engine, boiler and other finishing shops, a large and fully equipped blacksmith shop will be erected.

NEW COMPANIES.—American Coal & Steel Co., Chicago, Ill.; $3.000.000; J. Lazarus, H. Kelsey and H. A. Cors.——Murray-Miller Engineering Co., St. Louis, Mo.; $50,000; Charles Murray and F. B. Miller.